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Pectens from the Tertiary of Lower California

BY

Leo G Hertlein

Leland Stanford Junior University

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I

PECTENS FROM THE TERTIARY OF LOWER CALIFORNIA

BY

LEO G. HERTLEIN

Leland Stanford Junior University

In a study of a collection of Tertiary fossils from Lower California, a considerable number of species of Pectens were identified, several of which appear to be undescribed. The writer wishes to acknowledge the kind help received from Dr. J. P. Smith of the Leland Stanford Junior University; he also wishes to thank Dr. G. Dallas Hanna and Mr. Eric K. Jordan of the California Academy of Sciences for the loan of Academy material and helpful criticism of the manuscript. Permission by Dr. B. L. Clark to examine material in the collection of the University of California is gratefully acknowledged. Acknowledgment is also due especially to Mr. C. H. Beal and to Messrs. B. F. Hake, C. R. Swarts and T. J. Cullen of the Marland Oil Company of California; and also to Mr. E. Call Brown of Los Angeles, California, for the material collected by them. The greater part of this material is now in the paleontological collections of the Leland Stanford Junior University; paratypes where available, and duplicates, are in the collections of the California Academy of Sciences.

Previously described species of Pectens recognized in the collection are listed as follows, together with the L.S.J.U. and C.A.S. locality numbers from Lower California, and with the

formation as far as known. The formation-names and the names of the quadrangles in the most part follow those adopted by the Marland Oil Company geologists.

Pecten (Pecten) carrizoensis Arnold. Carrizo, Lower Pliocene.
Loc. 45 (L.S.J.U.)

Pecten (Pecten) cataractes Dall. Formation unknown.
Loc. 52 (L.S.J.U.)

Pecten (Pecten) cf. *bellus* Conrad. Salada, Pliocene.
Loc. 49 (L.S.J.U.); loc. 928 (C.A.S.)

Pecten (Pecten) hemphillii Dall. Salada, Pliocene.
Loc. 48 (L.S.J.U.)

Pecten (Pecten) keepi Arnold. Lower Pliocene?
Loc. 44, 45, 50 (L.S.J.U.)

Pecten (Pecten) lecontei Arnold. Salada, Pliocene.
Loc. 48 (L.S.J.U.); loc. 928 (C.A.S.)

Pecten (Patinopecten) cf. *coosensis* Shumard. Salada, Pliocene.
Loc. 48 (L.S.J.U.)

Pecten (Patinopecten) dilleri Dall. Salada, Pliocene.
Loc. 48 (L.S.J.U.)

Pecten (Lyropecten) near *crassicardo* Conrad.
Loc. 57 (L.S.J.U.)

Pecten (Plagioctenium) circularis Sowerby.
Loc. 47, 48, 61 (L.S.J.U.); loc. 928, 930 (C.A.S.)

Pecten (Plagioctenium) cerrosensis mendenhalli Arnold.
Carrizo, Lower Pliocene. Loc. 45, 51, 62, 69 (L.S.J.U.)

Pecten (Plagioctenium) deserti Conrad. Pliocene.
Loc. 45, 52, 55, 64 (L.S.J.U.)

Pecten (Plagioctenium) invalidus Hanna. Pliocene.
Loc. 52, 64 (L.S.J.U.)

Pecten (Plagioctenium) purpuratus Lamarck. Salada, Pliocene.
Loc. 48, 116 (L.S.J.U.); loc. 928, 930 (C.A.S.)

The localities (L.S.J.U.) and (C.A.S.) listed in the foregoing are as follows:

Locality 44 (L.S.J.U.). Arroyo Fortuna, north of San José del Cabo, Lower California; C. R. Swarts collector.

Locality 45 (L.S.J.U.). Santa Rosalia, Lower California; C. H. Beal collector.

Locality 47 (L.S.J.U.). Turtle Bay (San Bartolome), Lower California; B. F. Hake collector; Salada Pliocene.

Locality 48 (L.S.J.U.). Mouth of large arroyo, northwest of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California; B. F. Hake collector; Salada Pliocene.

Locality 49 (L.S.J.U.). Slopes of Salada, three miles southeast of Turtle Bay, uppermost beds, San Cristobal Bay Quadrangle, Lower California; B. F. Hake collector; Salada Pliocene.

Locality 50 (L.S.J.U.). Rancho Refugio, north of San José del Cabo, Lower California; C. R. Swarts collector.

Locality 51 (L.S.J.U.). Arroyo las Palmas, Santa Rosalia, Lower California.

Locality 52 (L.S.J.U.). El Zacato, on coast north of Santiago, Lower California; C. R. Swarts collector.

Locality 55 (L.S.J.U.). Arroyo Asuncion, Scammon Lagoon Quadrangle, Lower California; B. F. Hake collector.

Locality 57 (L.S.J.U.). La Purisima Cliffs, San Ramon River, Lower California; E. Call Brown Collector.

Locality 61 (L.S.J.U.). Coronados Island, Gulf of California; T. J. Cullen collector.

Locality 62 (L.S.J.U.). Float, five kilometers north of Santa Rosalia, Lower California; C. H. Beal collector.

Locality 64 (L.S.J.U.). Arroyo near La Palma, 12 miles northwest of Santa Rosalia, from pebbly sandstone near Comondu-Salada contact, Lower California; B. F. Hake collector.

Locality 69 (L.S.J.U.). Arroyo de las Virgines, 10 miles northwest of Santa Rosalia, Santa Rosalia Quadrangle, Lower California; B. F. Hake collector.

Locality 116 (L.S.J.U.). Cedros Island, off Lower California; H. Hemphill and others, collectors. Salada Pliocene.

Locality 928 (C.A.S.). Cedros Island, off Lower California; G. D. Hanna collector; Salada Pliocene.

Locality 930 (C.A.S.). Turtle Bay, Lower California; G. D. Hanna collector; Salada Pliocene.

Of the species listed in the foregoing *P. circularis* and *P. cataractes* are found living in the Gulf of California at the present time. *P. bellus* has been listed from the Fernando, San Diego, and Santa Barbara Pliocene of California, and *P. hemphillii* has been listed from the Fernando and San Diego Pliocene formations of southern California. *P. carrizoensis, P. deserti* and *P. keepi* have been reported from the Carrizo formation. *P. lecontei* has been reported from the Pliocene of Cedros Island. *P. invalidus* was described from the San Diego Pliocene of Pacific Beach near San Diego, California. *P. crassicardo* has been reported as occurring throughout the Miocene of California, though it is most abundant in the Monterey-Temblor and Santa Margarita-San Pablo formations. *P. cerrosensis mendenhalli* was originally described from the Plio-

cene of Lower California near Santa Rosalia, which was thought to be equivalent to the Carrizo. *P. purpuratus* occurs in the Salada Pliocene of Cedros Island and Turtle Bay, also in the Pliocene and Pleistocene of Chile, and it is at present found living in the waters of the Peruvian province of the Pacific ocean. *P. coosensis* occurs in the Miocene, Empire formation on the coast of Oregon and in the Montesano, Miocene of Washington. *P. dilleri* occurs in the Pliocene, Wildcat formation on Eel River in northern California and in the Fernando of the Santa Maria district near Santa Maria, California.

The numerous species of the sections Pecten s. str., Lyropecten, Aequipecten, and Plagioctenium, indicate that warm water conditions prevailed in Lower California in the later Tertiary. The identity of many of the previously described species with those known from the Tertiary of California is of interesting significance, as are also the relations of the new species. The stratigraphy of Lower California has not been worked out in great detail as yet, nor has any great advance been made in the way of correlation with the Tertiary formations of the western United States. Excellent work has, however, been accomplished by Dr. Arnold Heim and others. A recent paper by Heim[1] gives a good outline of the Tertiary stratigraphy of the southern half of the Peninsula of Lower California.

Several Tertiary and Quaternary formations were recognized by Heim. The Tepetate formation, considered to be of probable Upper Eocene age, is well developed at the Rancho El Tepetate, (Lat. 24° 23′, Long. 111° 8′). A stratum of about 20 meters of white siliceous shale appears at the base of the formation. This is followed by a considerable thickness of sandstones with smaller amounts of shales. Numerous *Orthophragmina pratti* Mich., occur in these beds, and *Amphistegina niasi* Verbeek, is also mentioned. The facies of the Tepetate formation, according to Heim, are chiefly neritic.

The next younger formation recognized by Heim is the Purisima Nueva (Lat. 26° 11′, Long. 112° 4′). These beds are said to be composed chiefly of light colored sandstones, with some

[1] Geol. Mag. Vol. 59, p. 529-547, 1922.

layers of broken shells. The facies are neritic. At places the beds are considerably metamorphosed. Some of the species listed from this formation are: *Mactra dariensis* Dall, *Pecten condylomatus* Dall, *Pecten oxygonum optimum* Brown & Pilsbry, *Raeta gibbosa* Gabb, *Turritella tristis* Brown, Balanus sp. The age of this formation was considered to be Upper Oligocene.

Along the Arroyo Cadegomo and at Rancho San Ramon (Long. 112° 12′), the Monterey formation is typically developed. This formation is composed largely of white siliceous shale with smaller amounts of sandstones and, according to Heim, is quite similar to the Monterey formation of California.

Conformably overlying and intergrading with the Monterey formation is the Isidro, named from the town of San Isidro on the left bank of the Arroyo San Gregorio. It consists largely of sandstones and shales and is neritic in facies. Genera of some of the fossils reported are: Arca, Chione, Mytilus, Psammobia, Tellina(?), Chrysodomus, Balanus.

The Isidro is overlain, at some localities conformably, elsewhere unconformably, by the usually flat-lying Comondú, named for the oasis village of that name. This formation is chiefly composed of brownish sandstones and conglomerates, which are thought to be continental, of great extension, and Upper Miocene, or possibly Lower Pliocene, in age.

Above. and slightly unconformable on the Comondú formation, are the Cuesta sandstones, well developed at La Cuesta de La Purisima. No fossils have been found and the beds are probably continental and Pliocene in age.

Unconformably overlying the Monterey at La Ventana, Heim found a marine conglomerate, which he suggested probably corresponds to the Fernando Pliocene of California, but to which no formational name was given.

At the cattle ranch La Salada, on the left bank of the Arroyo de La Salada, a marine Pliocene formation is well exposed, to which Heim gave the name Salada. This is composed largely of sandstones and occasional conglomerates with an upper calcareous stratum. These beds are thought to have been deposited in shallow water. The formation appears to be quite

extensively developed along the coast and at moderate distances inland, and was recognized at several points. Genera of some of the fossils listed are: Chione, Mytilus, Tellina, Calliostoma, Conus, Oliva, Polinices, Turritella, Balanus.

Along the Pacific coast, the Pliocene beds are covered by the Médanos, or older sand dunes. Marine shells are found in them which are thought to be of Pleistocene age. Some of the species found were: *Arca tuberculata* Sby., *Donax* cf. *cayennensis* Lam., *Tivela bryoniana (radiata* Dall), oysters, etc.

The writer has been informed by Mr. C. H. Beal that the conclusions reached by him and his associates concerning the Miocene stratigraphy of Lower California do not coincide in all respects with those of Dr. Heim. The Purisima Nueva of Heim was not recognized by them, and no fauna comparable to that listed by Arnold and Clark has been found in their collections. In the Pliocene, the Cuesta was not differentiated from the Comondú, and both together were considered to be the continental equivalent of the Salada.

In this paper, the writer, following Arnold, has used the term Carrizo for certain beds in Lower California, notably in the vicinity of Santa Rosalia. He recognizes that, as pointed out by Vaughan[2], the name Carrizo has been used several times in North American stratigraphy; furthermore, examination of faunas from Imperial County, California, indicates a possibility that the so called Carrizo of Carrizo Creek, Alverson Canyon and Coyote Mountain, may perhaps comprise more than one horizon.

Several of the species listed in the present paper are from the Pliocene of Lower California. The Pecten fauna indicates that the Pliocene of Cedros Island is in general the equivalent of the San Diego Pliocene of Pacific Beach, near San Diego, California. The Salada is apparently equivalent to the Pliocene of Cedros Island. There is, however, an indication in the fauna, that a horizon older than the Salada may be present on the west coast of Lower California, as well as on the east coast, and it is probable that some of the species referred to the Salada may belong to an older horizon.

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[2] Prof. Paper U. S. Geol. Survey No. 98, 1917, p. 357.

1. **Pecten (Pecten) refugioensis** Hertlein, new species

Plate 1, figure 2; plate 5, figure 9

Shell of medium size. Right valve practically smooth, ornamented, however, by fine concentric lines of growth, and close to the beaks also by fine, faint, radiating ribs which, however, disappear at the umbo; ventral margin smooth; interior of the shell ornamented by about 19 dichotomous ribs; ears about equal and concentrically sculptured; a slight groove showing where the ears meet the margins of the shell; a slight byssal notch present on the anterior ear. Left valve fairly smooth, ornamented interiorly much as right, a depressed area which is lower than the margins extends from the beaks to about one-half the height of the shell; ears slightly concave, ornamented by concentric lines of growth. Altitude 56 mm.; longitude 57 mm.; diameter of right valve approximately 14 mm.; apical angle of right valve approximately 97°.

Type: Right valve, No. 49 (L.S.J.U. type collection), from Loc. 50 (L.S.J.U.), **Rancho Refugio, north of San José del Cabo, Lower California**; *Paratypes:* No. 50 (L.S.J.U. collection), and Nos. 1764, 1765, 1766 (C.A.S. collection), C. R. Swarts collector; Upper Miocene or Lower Pliocene.

This species also occurs at Loc. 44 (L.S.J.U.), from Arroyo Fortuna, north of San José del Cabo, Lower California; C. R. Swarts collector; Upper Miocene or Lower Pliocene.

Pecten refugioensis appears to be a step between the sections Amusium and Pecten s. str. It has, in general, the shape of a Pecten s. str. and the concentric sculpture, ears and ribs are suggestive of an Amusium. It differs from *P. keepi* Arnold by showing scarcely any ribs on the exterior of the shell, and by its somewhat different shape. *P. refugioensis* differs from *P. revolutus* Mich., from the Miocene of Italy in having a smaller apical angle, a flatter shell, and differently shaped ears.

2. **Pecten (Pecten) aletes** Hertlein, new species

Plate 2, figures 1 and 4

Shell of medium size. Right valve moderately convex, ornamented by about 11 rather broad, flat-topped radiating ribs, which anteriorly and posteriorly decrease in size, each rib with one to four narrow, slight, radial sulcations; interspaces flat-bottomed, narrower than the ribs, occasionally bearing a tiny radiating riblet, the whole surface of valve sculptured by fine, close, concentric striæ; ears subequal, marked by growth lines, but lacking all radial sculpture. Left valve slightly concave, with a pronounced depression toward the beak; about nine flat-topped radial ribs, separated by interspaces about as wide as the ribs, the ribs and interspaces both covered by fine, sharp, concentric sculpture; ears subequal, and somewhat concave, ornamented only by fine incremental lines. Altitude 62 mm.; longitude 65 mm.; diameter of right valve approximately 13 mm.; apical angle of right valve approximately 100°.

Type: Right valve, No. 44 (L.S.J.U. type collection), from Loc. 50 (L.S.J.U.), **Rancho Refugio, north of San José del Cabo, Lower California**; *Paratypes:* No. 45 (L.S.J.U. collection), and No. 1767 (C.A.S. collection), C. R. Swarts collector. Horizon not known; probably Upper Miocene or Lower Pliocene.

Pecten aletes differs from *P. bellus* Conrad in the smaller number of ribs, which are finely sulcate. It differs from *P. laqueatus* Sowerby, from Japan, to which it is most closely related, in the fewer ribs; also in that the ears on the right valve of the present species appear to be straighter and not quite as arcuate as those of *P. laqueatus.*

3. **Pecten (Pecten) hartmanni** Hertlein, new species

Plate 1, figures 4 and 6

Right valve excessively arched, ornamented by about 16 or 17 rounded radiating ribs which become flattened toward the ventral margin of the shell; anterior and posterior margins highly arcuate, smooth except for faint lines of growth; ears somewhat convex and turned up slightly at the ends, the an-

terior sculptured by about four poorly defined radiating riblets which are crossed by concentric incremental lines, and cut by a slight byssal notch; left ear with a few faint radial riblets and slight concentric striæ. Altitude 75 mm.; longitude 65 mm.; diameter of right valve approximately 30 mm.; apical angle of right valve approximately 88°.

Type: Right valve, No. 48 (L.S.J.U. type collection), from Loc. 54 (L.S.J.U.), **Arroyo Mesquital, Lower California,** above the yellow silts which are well exposed in this arroyo; C. R. Swarts and T. J. Cullen collectors; Lower Pliocene?

Pecten hartmanni differs from *P. hemphillii* Dall in possessing a more highly arched right valve and in the shape of the ears, which in the present species are somewhat more concave. It differs from *P. cataractes* Dall in having fewer ribs, and in that the margins of the shell descend abruptly rather than expanding laterally, as in the case in Dall's species, and also in *P. vogdesi* Arnold.

This species is named in honor of Mr. A. Hartmann, whose work in Lower California has added to the knowledge of that region.

4. **Pecten (Pecten) heimi** Hertlein, new species

Plate 1, figure 3; plate 3, figure 3

Shell concavo-convex, equilateral, inequivalve. Right valve highly arched, and ornamented by about 20 or 21 rounded, radiating ribs which become flattened toward ventral margin, these separated by round-bottomed interspaces about one-half as wide as the ribs; ribs and interspaces crossed by concentric incremental lines of growth; ventral margin of shell rounded; ears somewhat convex; a distinct groove on right ear close to margin of shell, and byssal notch also present; anterior margin of right ear somewhat convex; ear ornamented by about four or five radiating riblets and by concentric incremental lines. Left valve slightly concave and ornamented by about 17 or 18 radiating ribs which are separated by round-bottomed interspaces, the ribs and interspaces crossed by fine concentric incremental lines; a depressed area present just below the beaks; anterior and posterior margins of valve flattened, higher than

the depressed inner area near beak, sloping abruptly to ears; ears concave and sculptured by fine incremental lines only. Altitude 75 mm.; longitude 85 mm.; diameter of right valve approximately 25 mm.; apical angle of right valve approximately 97°.

Type: Right valve, No. 46 (L.S.J.U. type collection), from Loc. 65 (L.S.J.U.), **southern part of Arroyo San Gregorio, Lower California**; *Paratype:* No. 47 (L.S.J.U. collection), E. R. Swarts and T. J. Cullen collectors; Lower Pliocene?

Pecten heimi differs from *P. hemphillii* Dall in the number of ribs, which is greater in *P. heimi,* and in the ears which are smooth, and more convex in the present species than in *P. hemphillii.* From *P. coalingensis* Arnold and *P. auburyi* Arnold it is distinguished by its larger size and the more rounded shape of its ribs; from *P. vogdesi* Arnold, by the fact that the shell in *P. heimi* does not flatten out at the ventral margin as does *P. vogdesi,* and *P. heimi* has a greater number of ribs than Arnold's species. *P. heimi* differs from *P. hartmanni* Hertlein, in being longer in proportion to the altitude, less inflated, and in possessing differently shaped ears. From *P. aztecus* Böse, *P. heimi* is distinguished by the fewer, more rounded, broader ribs, in the present species; furthermore, *P. heimi* is larger and apparently more convex.

This species is named in honor of Dr. Arnold Heim, whose work has added much to the knowledge of the geology of Lower California.

5. **Pecten (Pecten) beali** Hertlein, new species

Plate 2, figure 3; plate 5, figure 8

Shell inequivalve, plano-convex, equilateral, the ventral margin evenly rounded. Right valve convex, ornamented by about 23 or 24 prominent, square, flat-topped, strongly medially sulcate radial ribs, with in some cases, fainter radial grooves superimposed; interspaces flat-bottomed and slightly narrower than the ribs, the whole surface sculptured by fine, regular, concentric lines; posterior ear sculptured by about four radial riblets, and by fine incremental lines. Left valve flat or slightly concave, ornamented by about 21 radiating ribs

separated by flat-bottomed interspaces, each of which bears a single small intercalated riblet, the ribs and interspaces crossed by fine concentric lines; a somewhat depressed area is found just below the beak; margins of shell somewhat concave, bearing four or five radiating ribs and fine concentric imbricating lines; ears somewhat concave, ornamented by three or four radiating riblets and by fine concentric lines of growth. Altitude 55 mm.; longitude 56 mm.; diameter of right valve approximately 10 mm.; apical angle of right valve approximately 114°.

Type: Right valve, No. 55 (L.S.J.U. type collection), from Loc. 64 (L.S.J.U.), pebbly sandstone near Comondú-Salada contact, **Arroyo near La Palma, Lower California**; *Paratype:* Left valve No. 56 (L.S.J.U. collection), B. F. Hake collector, Salada, Pliocene.

Pecten beali appears to be related to *P. carrizoensis* Arnold, but is larger, and the ribs are more numerous and more deeply sulcate. On the left valve the radial interspaces are ornamented by small midribs which are lacking in Arnold's species. *P. carrizoensis* also is longer in proportion to the height than *P. beali.*

This species is named in honor of Mr. C. H. Beal, whose information concerning Lower California has been much appreciated by the writer.

6. **Pecten (Lyropecten) modulatus** Hertlein, new species

Plate 3, figure 6

Shell moderately convex, fairly heavy, showing slight areas of constricted growth. Right valve ornamented by about 14 longitudinally sculptured radiating ribs, which are rounded in the earlier part of the shell, but which, toward the ventral margin, show a tendency to become flattened; interspaces of varying width but all narrower than the ribs, all containing a small midrib; anterior and posterior margins of shell ornamented by fine longitudinal riblets; ears unequal, the anterior ear large, with large byssal notch and sculpture consisting of about seven well defined radial riblets and concentric growth lines, the left ear small in comparison with the large right, its

posterior edge sloping down almost vertically to the margin of shell, the surface of the ear ornamented by about eight or more radiating riblets over which are superimposed fine longitudinal and concentric lines. Altitude 58 mm.; longitude 60 mm.; diameter of right valve approximately 14 mm.; apical angle, right valve approximately 92°.

Type: Right valve, No. 39 (L.S.J.U. type collection), from Loc. 43 (L.S.J.U.), **Mesa west of Mesa de las Auras, Scammon Lagoon Quadrangle, Lower California**; B. F. Hake collector; Salada, Pliocene.

Pecten modulatus bears some resemblance to *P. vaughani* Arnold, but is much larger and also has sculptured margins and prominent midriblets in the interspaces, while in *P. vaughani* the interspaces bear fine striæ only.

7. **Pecten (Lyropecten) pretiosus** Hertlein, new species

Plate 2, figure 6; plate 3, figure 4

Shell small. Right valve moderately arched, and ornamented by about 17 or 18 rounded, radiating ribs, separated by somewhat narrower interspaces; ribs and interspaces sculptured by fine, radiating lines and crossed by fine, concentric lines of growth; anterior and posterior margins turning down abruptly, and smooth except for incremental striæ; ventral margin rounded and turned down abruptly; anterior ear with a distinct byssal notch, and a slight groove also present between ear and margin of shell; about five radiating riblets crossed by incremental lines ornament the ear; posterior ear sculptured by about six or seven radiating riblets, crossed by incremental striæ, the ear sloping downward and slightly posteriorly from the hinge line. Left valve ornamented by about 14 or 15 radiating ribs, the whole surface with sculpture similar to that of right valve; ears sculptured much as on right valve. Altitude 27 mm.; longitude 29 mm.; diameter of right valve approximately 10 mm.; apical angle of right valve approximately 87°.

Type: Right valve, No. 38 (L.S.J.U. type collection), from Loc. 59 (L.S.J.U.), Turritella bed above San Gregorio Lagoon, **120 miles north of Magdalena Bay, Lower California**, on the

trail from Arroyo Mesquital to La Purisima; *Paratypes:* No. 1770 (C.A.S. collection), from Loc. 59 (L.S.J.U.), and Nos. 89 (L.S.J.U. collection), and 1771 (C.A.S. collection), from Loc. 57 (L.S.J.U.), La Purisima Cliffs, on San Ramón River, Lower California; E. Call Brown collector; Isidro formation, Lower Miocene.

The characteristic shape, sculpture, and shape of ears distinguish this beautiful little Pecten from other species.

8. **Pecten (Aequipecten) percarus** Hertlein, new species

Plate 2, figures 2 and 5

Shell moderately large, equilateral, subequivalve, moderately thin, somewhat compressed, the outline round. Right valve ornamented by about 22 moderately strong, rounded ribs, separated by round-bottomed interspaces which are not quite as wide as the ribs; ribs and interspaces sculptured by regular, wavy, incremental lines, and, at irregular intervals, by stronger lines of growth; hinge line about one-half as long as the disk and slightly indented at the beaks; ears unequal, the anterior with a large byssal notch and sculpture consisting of about six or seven radiating riblets, the posterior ear ornamented by about seven radiating riblets, both ears sculptured by incremental lines. Left valve more arched and sharper at umbo than right, and somewhat one-sided in appearance, the disk ornamented by about 25 or 26 rounded, radiating ribs, and also concentrically sculptured much as on right valve; ears ornamented by about six or seven radiating ribs, crossed by concentric incremental lines; ears slightly concave, anterior with a slight byssal notch. Altitude 82 mm.; longitude 91 mm.; diameter approximately 12 mm.; apical angle of valves approximately 118°.

Type: No 42 (L.S.J.U. type collection), from Loc. 48 (L.S. J.U.), **mouth of large arroyo northwest of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California**; *Paratypes:* No. 43 (L.S.J.U. collection) and Nos. 1768, 1769 (C.A.S. collection), B. F. Hake collector, Salada Pliocene.

This species is also found at Loc. 76 (L.S.J.U.), Salada on white clay northwest of Elephant Mesa west of Arroyo,

Scammon Lagoon Quadrangle, Lower California; B. F. Hake collector; Salada, Pliocene. Also Loc. 928 (C.A.S.), Cedros Island; G. D. Hanna collector; Upper Pliocene. Also Loc. 930 (C.A.S.), from Turtle Bay, Lower California; G. D. Hanna collector; Salada, Pliocene.

Pecten percarus is distinguished from other west American Aequipectens by its large size, number of ribs, and its clear concentric incremental lines.

9. **Pecten (Plagioctenium) purpuratus** Lamarck

Plate 1, figure 1; plate 4, figures 2 and 4

1836. *Pecten purpuratus* LAMARCK, Hist. des Animaux sans Vertebres (edition by Deshayes and Edwards), Vol. 7, 1836, p. 134.

1843. *Pecten purpuratus* LAMARCK, SOWERBY, Thesaurus Conch., Vol. 1, 1843, p. 53, pl. 15, fig. 113; pl. 16, figs. 123-125.

1855. *Pecten purpuratus* LAMARCK, REEVE, Conchologia Iconica, Vol. 8, 1855, *Pecten*, pl. 5, fig. 25.

1910. *Pecten purpuratus* LAMARCK, DALL, Proc. U. S. Nat. Mus., Vol. 37, 1910, p. 149, pl. 26, figs. 5, 6.

Lamarck's description is as follows:

"P. testa alba, purpureo et nigro purpurascente varia; radiis 26, convexis; intus zona purpureo-nigricante."

Dall's description is as follows:

"Shell orbicular, moderately convex, subequivalve, rather thin, with about 26 flat-topped ribs, laterally fringed, and separated by channeled interspaces; colors white, rose color, and different shades of purple distributed in an irregular manner; the interior zoned with blackish purple."

Dall gave the recent distribution as being from Coquimbo, Chile, northward to Ecuador.

The three heavy, radiating riblets on the anterior ear of the right valve, and the sharply serrated edges of the radial ribs are characteristic of *Pecten purpuratus* Lamarck. *P. purpuratus* is found at the present time in the waters of the Peruvian province in the Pacific ocean. It occurs in the Pliocene and Pleistocene of Chile, but has not been reported previously from the Tertiary north of Panama. Specimens have been identified

from the Salada Pliocene at Turtle Bay, Lower California, and from the Pliocene of Cedros Island. The right valve figured in this paper came from Turtle Bay, the left from Cedros Island.

Possibly the left valve described as *P. subventricosus* by Dall from southern California and referred to *P. cerrosensis* by Arnold, is identical with *P. purpuratus* Lamarck.

10. **Pecten (Plagioctenium) cerrosensis** Gabb

Plate 6, figure 1

1869. *Pecten cerrosensis* GABB, Geol. Surv. Calif., Pal., Vol. 2, 1869, p. 32, pl. 9, figs. 55, 55a.

1906. Not *Pecten (Plagioctenium) cerrosensis* GABB, ARNOLD, Prof. Paper U. S. Geol. Survey, No. 47, 1906, pp. 123-124, pl. 44, fig. 5; pl. 49, figs. 1, 1a, 1b.

Gabb's original description is as follows:

"Shell equivalve, subcircular, broader than long, convex; beaks small; sides sloping concavely above, rounded below; ears small, subequal, roughened and irregular, sinus very small. Surface marked by eighteen or twenty flat ribs, with flat or slightly concave interspaces; margins undulated, the ends of the ribs being deeply emarginated, and the interspaces being prolonged into tongue-like processes."

"*Locality:* Cerros Island, off the coast of Lower California: probably Miocene. Collected by Dr. J. A. Veatch."

The dimensions of the type are approximately: altitude 210 mm.; longitude 220 mm.; diameter 90 mm. It is No. 1091 (Univ. Calif. Coll.) and is figured herewith through the kindness of Prof. Bruce L. Clark.

It appears to the writer that several different species have been assigned to *P. cerrosensis* Gabb. Having examined the type which is in the collections of the University of California, it appears that the description and figures given by Arnold can hardly belong to the species described by Gabb; the description and figures given by Arnold do not coincide with the type, original figure or description. *P. cerrosensis* Gabb has 18 to 20 ribs, a very slight byssal notch, and the ears, except for growth lines, are perfectly smooth, while in the figures shown by Arnold a deep byssal notch is present in the anterior

ear of the right valve, there are more than 20 radiating ribs, and the ears are sculptured by radiating riblets. As stated elsewhere in this paper, one of Arnold's figures may be *P. purpuratus* Lamarck, and the others appear to be *P. subdolus* Hertlein.

The slight byssal notch, unsculptured ears, and the number of ribs are characteristic of *P. cerrosensis.*

11. **Pecten (Plagioctenium) cerrosensis mendenhalli** Arnold

Plate 1, figure 5

1906. *Pecten (Plagioctenium) cerrosensis* var? *mendenhalli* Arnold, Prof. Paper U. S. Geol. Survey, No. 47, 1906, pp. 84-85, pl. 25, figs. 2, 2a, and 2b.

Arnold's original description is as follows:

"Shell, when adult, averaging about 75 millimeters in altitude. Similar to *P. cerrosensis* in shape, convexity, and ribbing, but differing from the latter in being much smaller when adult, having fewer ribs (about 19 in the former, while the latter has usually 21 or more), much less prominent incremental lines, and a relatively longer hinge line."

"*Dimensions (of a medium-sized specimen).*—Alt. 43 mm.; long. 44 mm.; hinge line 28 mm.; diameter 17 mm."

"The type is from beds of probable Miocene age (the equivalent of the Carrizo Creek beds) at Santa Rosalia, Lower California, directly west of and across the Gulf of California from Guaymas, Mexico."

Several different species have been referred to *Pecten cerrosensis mendenhalli* Arnold by various workers. A specimen from near the type locality is figured herewith. This form is apparently more closely related to the true *P. cerrosensis* Gabb than are the other forms referred to the latter by Arnold.

It should be mentioned that Gabb's original description of *P. cerrosensis* states that the ribs are 18 to 20 in number and not 21 or more.

12. **Pecten (Plagioctenium) calli** Hertlein, new species

Plate 4, figures 5, 6 and 7

Shell small, inequivalve. Right valve slightly arched, ornamented by about 16 or 17 rather high, narrow, rounded, radiating ribs separated by interspaces of about the same width as

the ribs; anterior ear with a large byssal notch and sculpture consisting of about five radiating riblets crossed by concentric lines of growth; posterior ear sculptured by radiating riblets crossed by concentric lines of growth. Left valve slightly prolonged posteriorly, much more highly arched than right, and sloping rather abruptly from the umbos, sculptured by about 19 well developed, rather sharp, rounded, radiating ribs separated by interspaces about as wide as the ribs, ribs and interspaces crossed by fine concentric lines; ears slightly concave, the anterior with a small notch and ornamentation consisting of five or six radiating riblets crossed by concentric lines of growth; posterior ear slightly prolonged at the hinge line, sculptured as right. Altitude 24 mm.; longitude 24 mm.; diameter of left valve approximately 7 mm.; apical angle approximately 90°.

Type: Left valve, No. 68 (L.S.J.U. type collection), from Loc. 53 (L.S.J.U.), first arroyo east of Santiago, Lower California, C. R. Swarts collector; Miocene? *Paratype:* No. 125 (L.S.J.U. collection), same locality as the type; also No. 126 (L.S.J.U. collection), from Loc. 63 (L.S.J.U.), intersection of Arroyo Fortuna with Arroyo Refugio, near San José del Cabo, Lower California, C. R. Swarts collector; also No. 127 (L.S. J.U. collection) from Loc. 60 (L.S.J.U. collection), west side of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California, B. F. Hake collector: Isidro formation, Lower Miocene; also No. 1772 (C.A.S. collection), from Turtle Bay, Lower California, E. C. Johnson collector; Pliocene.

Pecten calli differs from *P. andersoni* Arnold, in its narrower ribs and more highly arched left valve. From *P. discus* Conrad, and *P. raymondi* Clark, the present species is distinguished by the differently shaped ribs and less circular outline of the valves. From *P. deserti* Conrad and *P. impostor* Hanna, *P. calli* is distinguished by its high narrow, rounded ribs and only slightly arched right valve. From *P. santarosanus* Böse, *P. calli* is distinguished by the fewer higher ribs and by the presence of a profound rounded notch in the posterior ear of the left valve of the present species, which notch is lacking in *P. santarosanus*.

July 21, 1925

This species is named in honor of Mr. E. Call Brown, whose collection has added to the knowledge of the stratigraphy of Lower California.

13. **Pecten (Plagioctenium) hakei** Hertlein, new species

Plate 4, figures 1 and 3

Shell moderately arched, coarse and thick, slightly longer than high. Right valve ornamented by about 23 or 24 rounded to slightly flat-topped ribs, separated by narrower, round-bottomed interspaces, both the interspaces and ribs crossed by concentric incremental lines, and, in some cases, by rather strong lines of growth; anterior ear with a large byssal notch, and sculpture consisting of about five or six radiating riblets, crossed by concentric incremental lines; anterior and posterior margins of valves smooth except for concentric incremental lines; ventral margin rounded; posterior ear ornamented by about eight radiating riblets and by lines of growth, the posterior edge of the ear forming nearly a right angle with the hinge line. Left valve convex, higher at the umbo than the right valve, and ornamented by about 24 or 25 squarish, flat-topped, rounded ribs, separated by narrower, round-bottomed interspaces, the whole valve sculptured by concentric lines of growth; ears slightly concave, ornamented by about six or seven radiating riblets. Altitude 90 mm., longitude 95 mm.; diameter of right valve approximately 15 mm.; apical angle of right valve approximately 114°.

Type: Right valve, No. 40 (L.S.J.U. type collection), from Loc. 47 (L.S.J.U.), **Turtle Bay, Lower California**; *Paratypes:* No. 41 (L.S.J.U. collection) and Nos. 1773, 1774 (C.A.S. collection), B. F. Hake collector; Salada, Pliocene.

This species is also found at Loc. 46 (L.S.J.U.), post-Eocene sandstone, at north edge of a tilted mesa about five miles north of Abreojos Point, Ballenas Bay Quadrangle, Lower California, B. F. Hake collector; Salada, Pliocene; also Loc. 42 (L.S.J.U.) above San Juan Arroyo, about five miles southwest of Jesus Maria, Jesus Maria Quadrangle, Lower California, C. H. Beal collector; Salada, Pliocene.

Pecten hakei differs from *P. cerrosensis mendenhalli* Arnold in its larger size, more numerous ribs and stronger concentric sculpture and large byssal notch. It differs from *P. purpuratus* Lamarck in bearing more numerous ribs, and in having a less rounded outline; also in lacking the lateral serrations on the radial ribs which characterize *P. purpuratus*. From *P. cerrosensis* Gabb, proper, it is distinguished by the much larger byssal notch in the anterior ear of the right valve, by the strongly sculptured ears, which, except for growth lines, are smooth in *P. cerrosensis,* and by the number of ribs, 23 to 24 in the present species rather than 18 to 20 in the species described by Gabb.

This species is named in honor of Mr. B. F. Hake, who collected considerable material which has added to the knowledge of the stratigraphy of Lower California.

14. **Pecten (Plagioctenium) cristobalensis** Hertlein, new species

Plate 3, figures 1, 2 and 5

Shell large, fairly thick, in several specimens with strong lines of restricted growth; valves moderately arched. Right valve ornamented by about 24 flat-topped, squarish, radiating ribs, separated by flat-bottomed, slightly narrower, interspaces, the whole surface crossed by well defined, wavy, concentric lines of growth; anterior and posterior margins of valve smooth except for concentric incremental sculpture; ventral margin evenly rounded; ears unequal, the anterior ear with a large byssal notch, and ornamented by about five radiating riblets crossed by concentric lines of growth; the posterior ear also bearing about five or six radiating riblets crossed by growth lines. Left valve slightly more convex than right and sculptured much as the latter, the anterior and posterior margins with concentric lines of growth only; ears ornamented by about eight or nine radiating riblets, the anterior ear with a slight notch. Altitude 117 mm.; longitude 135 mm.; diameter right valve approximately 17 mm.; apical angle of right valve approximately 100°-110°.

Type: Right valve, No. 36 (L.S.J.U. type collection), from Loc. 49 (L.S.J.U.), **slopes of Salada three miles southeast of**

Turtle Bay, uppermost beds, San Cristobal Bay Quadrangle, Lower California; *Paratypes:* No. 37 (L.S.J.U. collection) and Nos. 1775, 1776 (C.A.S. collection), B. F. Hake collector; Salada, Pliocene.

The species was also found at Loc. 48 (L.S.J.U.), at the mouth of a large arroyo northwest of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California.

Pecten cristobalensis is distinguished from *P. cerrosensis mendenhalli* Arnold, by its squarish, more numerous ribs. The greater number of radial, squarish ribs, separated by narrower interspaces, and the less strong development of concentric incremental lines, distinguish the present species from *P. cerrosensis* Gabb proper. *P. cristobalensis* has a large byssal notch in the anterior ear of the right valve, and the ears are more strongly sculptured by radiating riblets than in *P. cerrosensis,* in which the byssal notch is very slight, and, except for lines of growth, the ears are smooth. From *P. callidus* Hertlein, *P. cristobalensis* differs in the more numerous ribs, different ears, and rounder outline. The distinction between the present species and *P. purpuratus* Lamarck is based largely upon the character of the radial ribs and of the anterior ear of the right valve. The ribs of *P. purpuratus* are wider and lower than those of *P. cristobalensis;* and conversely, the interspaces are narrower in *P. purpuratus;* furthermore the ribs of the latter species expand much more rapidly toward the ventral margin than do those of *P. cristobalensis.* The lateral serrations on the radial ribs, so strongly developed in Lamarck's species, are very slight in the present form. The presence of three very strong ribs on anterior ear of right valve of *P. purpuratus* with only a vestige of a fourth, rather than five less strong riblets as in *P. cristobalensis,* is also an evident and apparently constant difference.

15. **Pecten (Plagioctenium) subdolus** Hertlein, new species

Plate 5, figures 2, 4 and 7

1906. *Pecten (Plagioctenium) cerrosensis* Gabb, Arnold, Prof. Paper U. S. Geol. Survey, No. 47, 1906, pp. 123-124, (ex parte), pl. 49, figs. 1, 1a, 1b.

1869. Not *Pecten cerrosensis* Gabb, Geol. Surv. Calif., Vol. 2, 1869, p. 32, pl. 9, figs. 55, 55a.

Shell of medium size, the valves moderately convex. Right valve ornamented by about 21 rounded, radiating ribs which become broader toward the ventral margin, the ribs separated by round-bottomed, narrower interspaces, the whole surface ornamented by very fine radial striations and by concentric lines of growth; anterior and posterior margins sculptured only by concentric incremental lines; ventral margin rounded; ears unequal, the anterior with a well defined byssal notch, and sculpture of about six radiating riblets crossed by incremental lines; the posterior also sculptured by about six or seven slight radiating riblets crossed by lines of growth, a very slight notch present. Left valve more arched than right and somewhat one-sided in appearance, ornamented by about 21 rounded, radiating ribs separated by round-bottomed interspaces about as wide as the ribs, the whole surface finely longitudinally striate and crossed by concentric lines of growth; ears slightly concave, the posterior sculptured by very slight radiating riblets and concentric lines of growth, the anterior with a rounded notch, the surface sculptured by a few very slight radiating riblets and by concentric growth lines, the ornamentation indistinct on weathered specimens. Altitude 50 mm.; longitude 50 mm.; diameter approximately 17 mm.; apical angle in each valve approximately 105°.

Type: No. 51 (L.S.J.U. type collection), from Loc. 115 (L.S.J.U.), **Pacific Beach, San Diego, California**; *Paratypes:* No. 52 (L.S.J.U. collection), and No. 1777 (C.A.S. collection), C. H. Sternberg collector; San Diego, Pliocene.

This species also occurs at Loc. 116 (L.S.J.U.), in the Pliocene of Cedros Island, from which locality a specimen attains an approximate height of 110 mm.; length 110 mm.; diameter 30 mm.

From *P. cerrosensis*, *P. subdolus* differs in its more numerous rounded ribs, large byssal notch, sculptured rather than smooth ears and usually smaller size. It differs from *P. callidus* in its rounded ribs which are not as high as those of the latter, in the presence of fine radial striæ on the disk, and in the less strong sculpture of the ears in the present species.

16. **Pecten (Plagioctenium) callidus** Hertlein, new species

Plate 5, figures 1, 3, 5 and 6

Shell of medium size, the valves moderately arched. Right valve ornamented by about 21 or 22 rather high, flat-topped, radiating ribs separated by narrower interspaces, tops of ribs smooth, but sides and interspaces sculptured by fine, sharp lamellæ; anterior and posterior margins sculptured by concentric lines of growth only; ventral margin rounded; ears unequal, the anterior with a large byssal notch and ornamented by about five or six radiating riblets crossed by concentric lines of growth; the posterior sculptured by several radiating riblets. Left valve more convex than right and somewhat one-sided in appearance, with sculpture quite similar to that of right valve except that the interspaces are slightly wider; anterior ear carrying a small, rounded notch and ornamentation consisting of small, radiating riblets and concentric lines of growth; posterior ear sculptured much as the anterior. Altitude 55 mm.; longitude 55 mm.; diameter 19 mm.; apical angle of valves approximately 105°.

Type: No. 53 (L.S.J.U. type collection), from Loc. 116 (L.S.J.U.), **Cedros Island, Lower California**; *Paratypes:* No. 54 (L.S.J.U. collection), H. Hemphill collector; Salada, Pliocene.

This species was found also at Loc. 48 (L.S.J.U.), from mouth of big Arroyo northwest of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California; B. F. Hake collector; Salada Pliocene.

In the Fernando Lower Pliocene of southern California, at several localities, this species also appears to be quite abundant.

Pecten callidus differs from *P. subdolus* Hertlein in having higher, narrower, smooth rather than striate, flat-topped ribs, the interspaces crossed by very fine lamellæ which are largely lacking in *P. subdolus*. It differs from *P. cerrosensis* Gabb, in its larger byssal notch, radially sculptured ears, more numerous ribs, and usually smaller size. Possibly *P. callidus* was the square-ribbed species from the Fernando formation of southern California which Arnold referred to *P. cerrosensis*.

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Plate I

Fig. 1. *Pecten* (*Plagioctenium*) *purpuratus* Lamarck; X⅝; plesiotype, left valve, No. 90 (L. S. J. U. Type Coll.), from Loc. 116 (L. S. J. U.), Cedros Island, Salada Pliocene; p. 14.

Fig. 2. *Pecten* (*Pecten*) *refugioensis* Hertlein, new species; natural size; type right valve, No. 49 (L. S. J. U. Type Coll). ,from Loc. 50 (L. S. J. U.), Rancho Refugio, north of San Jose del Cabo, Lower California. Upper Miocene or Lower Pliocene; p. 7.

Fig. 3. *Pecten* (*Pecten*) *heimi* Hertlein, new species; X⅝; type, right valve, No. 46 (L. S. J. U. Type Coll.), from Loc. 65 (L. S. J. U.), southern part of San Gregorio Arroyo, Lower California; p. 9.

Fig. 4. *Pecten* (*Pecten*) *hartmanni* Hertlein, new species; X⅝; type, right valve, No. 48 (L. S. J. U. Type Coll.), from Loc. 54 (L. S. J. U.), Arroyo Mesquital, Lower California. Above the yellow silts which are well exposed in this arroyo. Lower Pliocene?; p. 8.

Fig. 5. *Pecten* (*Plagioctenium*) *cerrosensis mendenhalli* Arnold; X⅝; plesiotype, right valve, No. 91 (L. S. J. U. Type Coll.), from Loc. 62 (L. S. J. U.), float five kilometers north of Santa Rosalia, Lower California. Carrizo, Lower Pliocene? p. 16.

Fig. 6. *Pecten* (*Pecten*) *hartmanni* Hertlein, new species; natural size; type, same specimen as figure 4; p. 8.

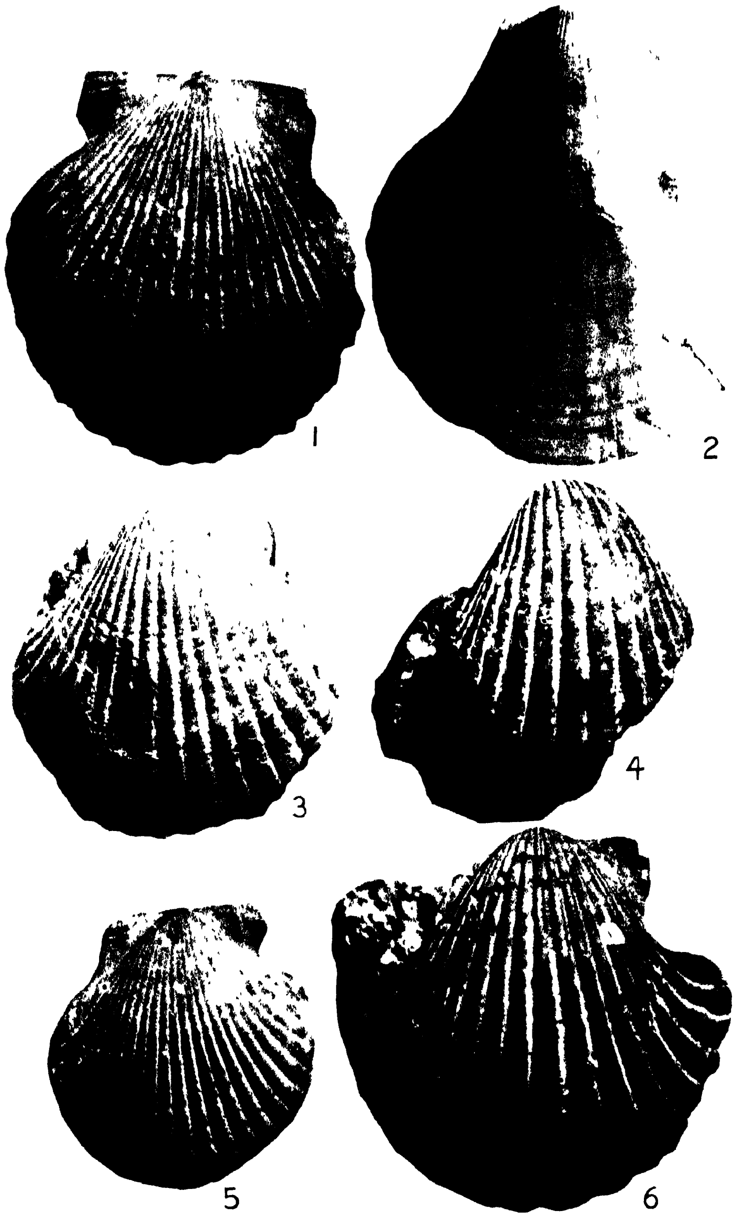
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PLATE III

Fig. 1. ***Pecten (Plagioctenium) cristobalensis*** Hertlein, new species; natural size; paratype, right valve, No. 94 (L. S. J. U. Type Coll.) from Loc. 49 (L. S. J. U.), slopes of Salada three miles southeast of Turtle Bay, uppermost beds, San Cristobal Bay Quadrangle, Lower California, Salada Pliocene, p. 19.

Fig. 2. ***Pecten (Plagioctenium) cristobalensis*** Hertlein, new species; natural size; type, right valve, No. 36 (L. S. J. U. Type Coll.). Same locality as Fig. 1, p. 19.

Fig. 3. ***Pecten (Pecten) heimi*** Hertlein, new species; natural size; paratype, left valve, No. 47 (L. S. J. U. Type Coll.), from Loc. 65 (L. S. J. U.), southern part of San Gregorio Arroyo, Lower California. Lower Pliocene? p. 9.

Fig. 4. ***Pecten (Lyropecten) pretiosus*** Hertlein, new species, natural size; type, right valve, No. 38 (L. S. J. U. Type Coll.), from Loc. 59 (L. S. J. U.), *Turritella* bed above San Gregorio Lagoon, 120 miles north of Magdalena Bay, Lower California, on the trail from Arroyo Mesquital to La Purisima. Isidro formation. Lower Miocene; p. 12.

Fig. 5. ***Pecten (Plagioctenium) cristobalensis*** Hertlein, new species, natural size; paratype, left valve, No. 37 (L. S. J. U. Type Coll.). Same locality as Fig. 2; p. 19.

Fig. 6. ***Pecten (Lyropecten) modulatus*** Hertlein, new species; natural size; type, right valve, No. 39 (L. S. J. U. Type Coll.), from Loc. 43 (L. S. J. U.), Mesa west of Mesa de las Auras, Scammon Lagoon Quadrangle, Lower California. Salada (?) Pliocene; p. 11.

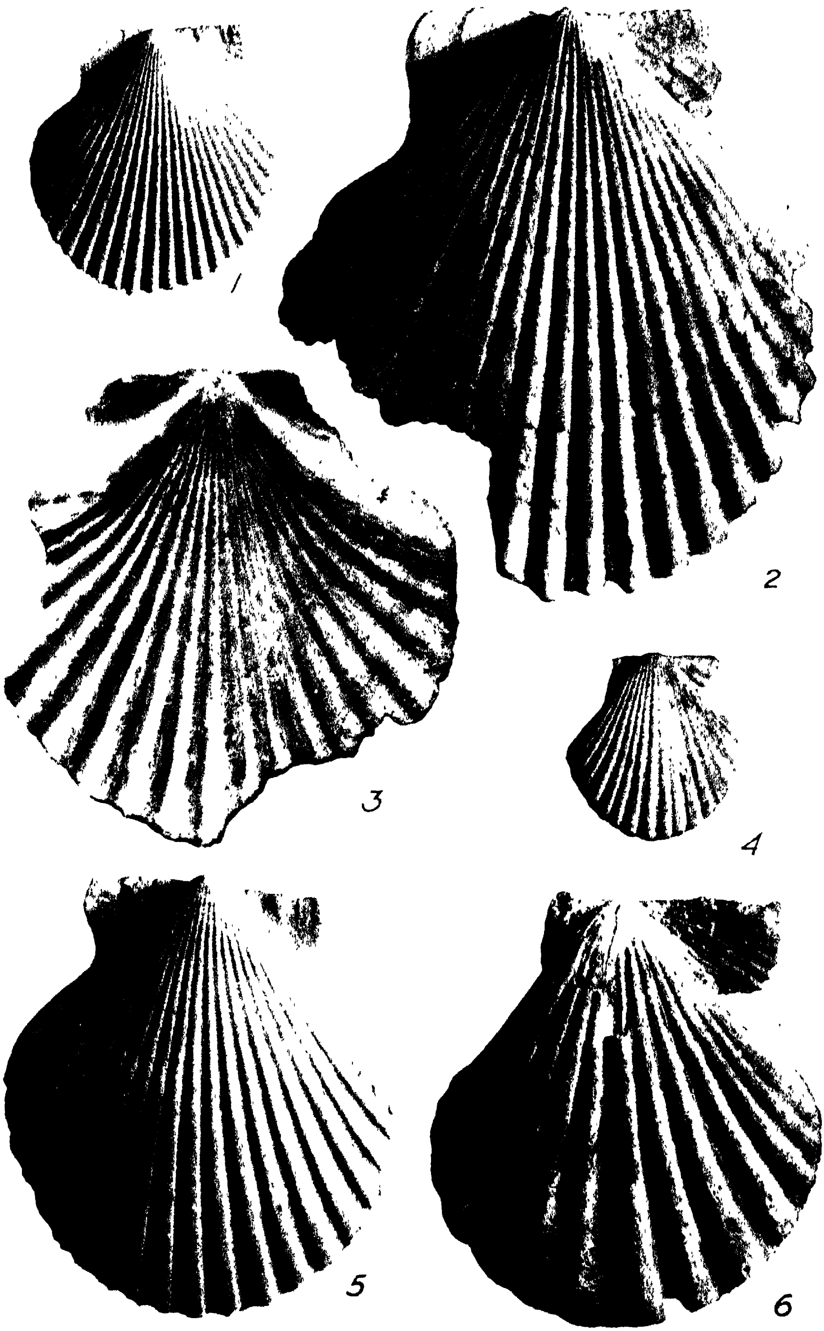
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PLATE IV

Fig. 1. *Pecten (Plagioctenium) hakei* Hertlein, new species ;X$^2_3$; type, right valve, No. 40 (L. S. J. U. Type Coll.), from Loc. 47 (L. S. J. U.), Turtle Bay, Lower California. Salada Pliocene; p. 18.

Fig. 2. *Pecten (Plagioctenium) purpuratus* Lamarck; X$^2_3$, plesiotype, right valve, No. 1778 (C. A. S. Type Coll.), from Loc. 930 (C. A. S.), Turtle Bay, Lower California. Salada Pliocene, p. 14.

Fig. 3. *Pecten (Plagioctenium) hakei* Hertlein, new species; X$^2_3$; paratype, left valve, No. 41 (L. S. J. U. Type Coll.). Locality same as Fig. 1; p. 18.

Fig. 4. *Pecten (Plagioctenium) purpuratus* Lamarck, natural size; plesiotype, right valve, No. 1779 (C. A. S. Type Coll.), from Loc. 928 (C. A. S.), Cedros Island, Lower California. Salada Pliocene; p. 14.

Fig. 5. *Pecten (Plagioctenium) calli* Hertlein, new species; X3; paratype, right valve, No. 125 (L. S. J. U. Type Coll.), from Loc. 60 (L. S. J. U.), west side of Elephant Mesa, Scammon Lagoon Quadrangle, Lower California. Isidro formation, Lower Miocene; p. 16.

Fig. 6. *Pecten (Plagioctenium) calli* Hertlein, new species; natural size; type, left valve, No. 68 (L. S. J. U. Type Coll.), from Loc. 53 (L. S. J U.), first arroyo east of Santiago, Lower California. Miocene? p. 16.

Fig. 7. *Pecten (Plagioctenium) calli* Hertlein, new species; X3; paratype, left valve of specimen Fig. No. 5. p. 16.

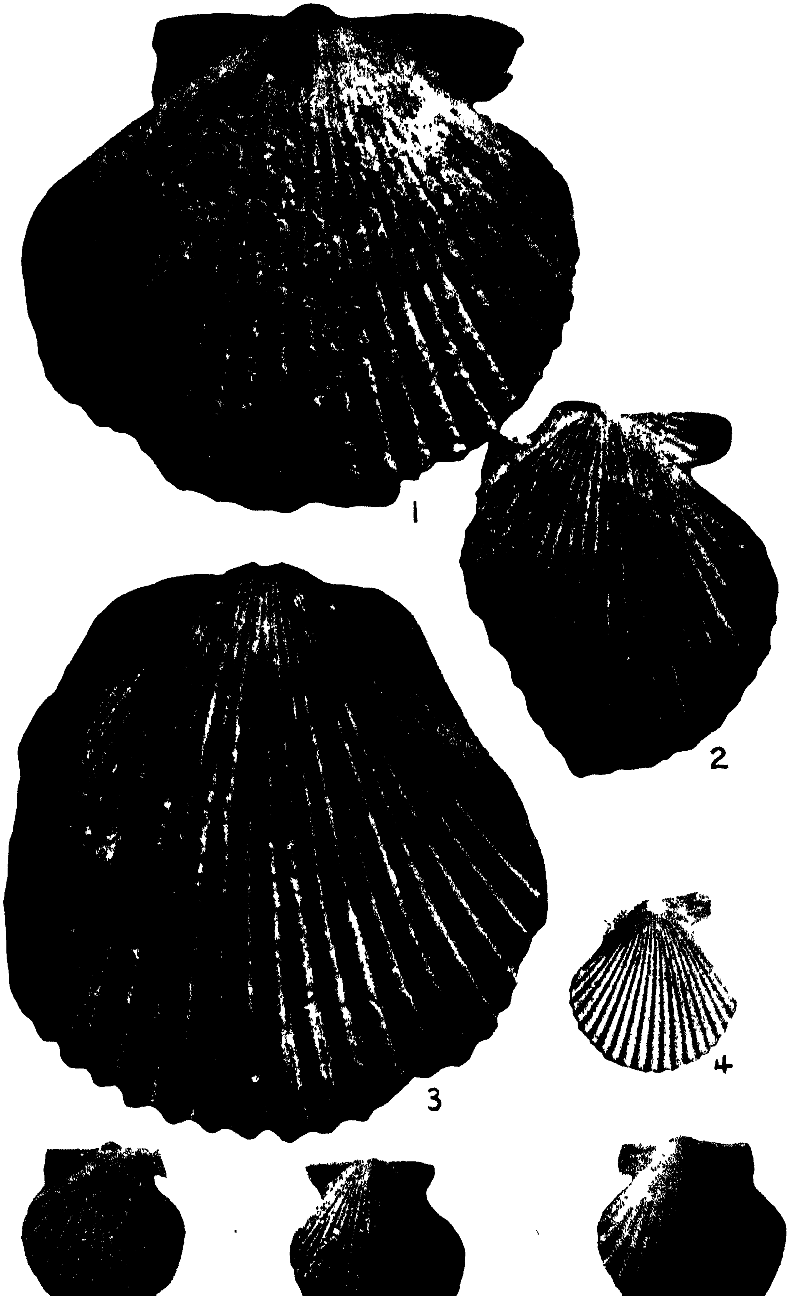
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PLATE V

FIG. 1. *Pecten (Plagioctenium) callidus* Hertlein, new species; natural size; type, right valve, No. 53 (L. S. J. U. Type Coll.), from Loc. 116 (L. S. J. U.), Cedros Island. Salada Pliocene. p. 22.

FIG. 2. *Pecten (Plagioctenium) subdolus* Hertlein, new species; natural size; paratype, right valve, No. 52 (L. S. J. U. Type Coll.), from Loc. 115 (L. S. J. U.), Pliocene of Pacific Beach, near San Diego, California. San Diego Pliocene. p. 20.

FIG. 3. *Pecten (Plagioctenium) callidus* Hertlein, new species; natural size; paratype, right valve, No. 54 (L. S. J. U. Type Coll.), from Loc. 116 (L. S. J. U.), Cedros Island. Salada Pliocene p. 22.

FIG. 4. *Pecten (Plagioctenium) subdolus* Hertlein, new species, natural size; type, right valve, No. 51 (L. S. J. U. Type Coll.), from Loc. 115 (L. S. J. U.), Pliocene of Pacific Beach, near San Diego, California. San Diego Pliocene; p. 20.

FIG. 5. *Pecten (Plagioctenium) callidus* Hertlein, new species, natural size; type, left valve. Same specimen as Fig. 1, p. 22

FIG. 6. *Pecten (Plagioctenium) callidus* Hertlein, new species; natural size, paratype, left valve, No. 54 (L. S. J. U. Type Coll.), Same specimen as Fig. 3; p. 22

FIG. 7. *Pecten (Plagioctenium) subdolus* Hertlein, new species, natural size, type, left valve. Same specimen as Fig. 4; p. 20.

FIG. 8. *Pecten (Pecten) beali* Hertlein, new species; natural size; paratype, left valve, No. 56 (L. S. J. U. Type Coll.), from Loc. 64 (L. S. J. U.), pebbly sandstone near Comondu-Salada contact, Arroyo near La Palma, Lower California. Probably Carrizo, Lower Pliocene? p. 10.

FIG. 9. *Pecten (Pecten) refugioensis* Hertlein, new species; natural size; paratype, left valve, No. 50 (L. S. J. U. Type Coll.), from Loc. 50 (L. S. J. U.), Rancho Refugio, north of San Jose del Cabo, Lower California. Upper Miocene or Lower Pliocene. p. 7.

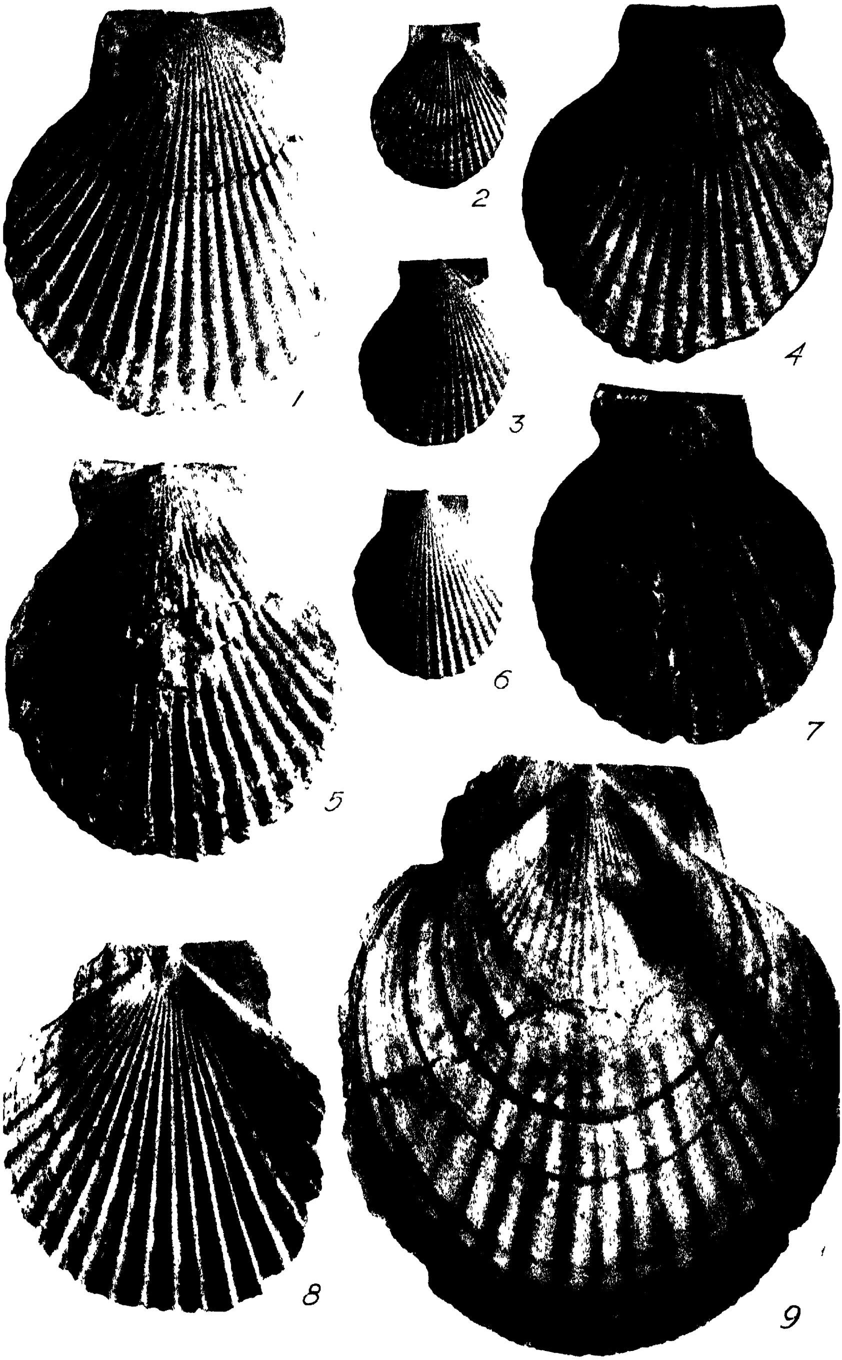
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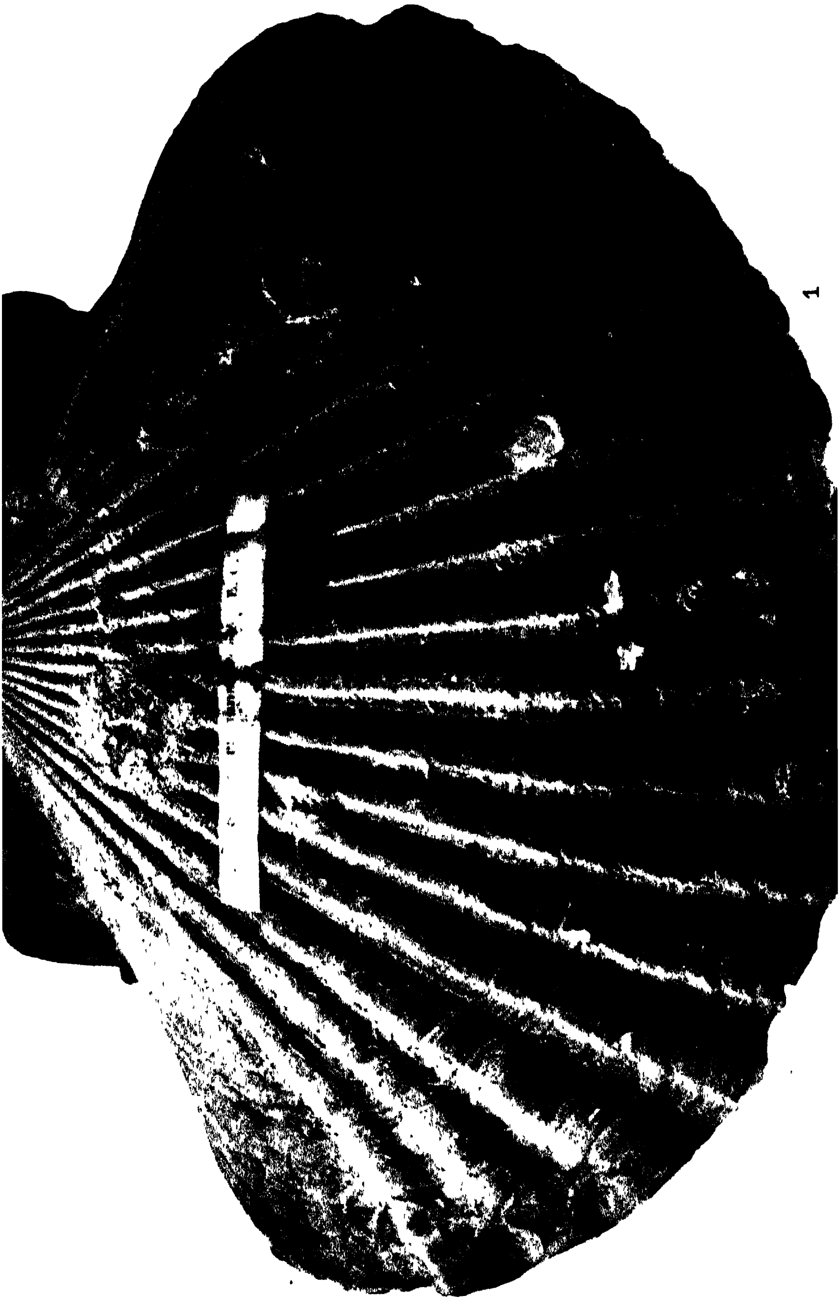
PLATE VI

FIG. 1. *Pecten (Plagioctenium) cerrosensis* Gabb.; $\times\frac{7}{10}$; type, right valve (U. of Calif. collection), from Pliocene of Cedros Island, Lower California. Salada, Pliocene; p. 15.



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II

CONTRIBUTION TO THE TERTIARY PALEONTOLOGY OF PERU

BY

G. DALLAS HANNA

AND

MERLE C. ISRAELSKY

Department of Paleontology

INTRODUCTION

In 1914 Mr. G. C. Gester collected a considerable number of Tertiary fossils in Peru and soon after presented them to the California Academy of Sciences. Dr. Roy E. Dickerson, then Curator of the Department of Paleontology, intended to prepare a report upon the collection for publication, and he identified many of the species contained therein, but before the work was completed he was called to other duties.

Later, through the kindness of Mr. John G. Burtt of the Shell Oil Company of California, another collection made in the same region by Mr. Arthur May was donated to the Academy.

The purpose of this paper is to place on record these interesting and valuable collections. Through the development of the petroleum bearing formations of northern South America during recent years much attention has been attracted to the region and several extensive reports have been published on the geology and paleontology. Large collections have been made

in Panama and Colombia as well as in Peru, and the Academy has fared exceedingly well in the distribution of these. It is believed that the publication of further technical reports on the paleontology will aid geologists materially in the field work necessary to an accurate mapping of the areas of prospective or proved productivity.

In the preparation of this report it was found necessary to prepare a checklist of species previously described and listed from the Tertiary of Peru. This has been so exceedingly helpful to us that we believe it desirable to publish it at this time in order that all references to previous systematic work may be available in one place to future workers. It has been made as nearly complete as possible and it is not believed many references have been missed. In consulting the checklist, however, it should be remembered that a considerable number of species have been listed or described from Peru from formations older than the Tertiary, from the Cretaceous down to and including the Silurian. We have not collected references to these.

We wish to express the appreciation of the Academy to Mr. Gester and Mr. Burtt for the collections concerned, and also to acknowledge our indebtedness to Dr. Dickerson for the work in the identification of species previous to our attempts.

Previous Work

In 1909 George I. Adams[1] published "An Outline Review of the Geology of Peru" in which he gave a resumé of previous work which had been done. His bibliography (pp. 428-430) professedly incomplete, contains 41 titles; these include all the important papers on the paleontology of the region which had appeared up to that time. Since then two extensive accounts of the fossils of the Eocene and Miocene of Peru have appeared; one by Spieker[2], the other by Woods, Vaughan, and Cushman[3]. As often happens, these books were printed the same year and since there is a conflict of names it became important to know which was actually distributed first to the public. In response to inquiries made of the publishers it has

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[1] Annual Report, Smithsonian Institution for 1908 (1909) pp. 385-430, 5 pls.
[2] Johns Hopkins University, Studies in Geology, No. 3, September 8, 1922.
[3] In Bosworth, Geology of the Tertiary and Quaternary periods in the northwest part of Peru; Macmillan & Co. Ltd., London, October 3, 1922, pp. XXII, 1-434, many plates.

been learned that Spieker's paper appeared on September 8, 1922[4]; the Macmillan Company has stated that the volume by Bosworth and others was published on October 3, 1922[5]; therefore priority of publication is accredited to Spieker in the following checklist wherever a conflict has been found.

Space has not been taken to give a running list of the species in the collections, but each one is noted in its proper place in the checklist.

LIST OF COLLECTING STATIONS IN PERU

328.[6] "Near the top of a small hill on the south side of Corona peak." G. C. Gester, Coll. No. 7.

329. "Ridge line near Corona Peak, north coast of Peru." G. C. Gester, Coll. No. 6.

330. "Timbes Peru:—two miles up river at top of hill." G. C. Gester, Coll. (Pleistocene.)

331. "Sea cliff; from a sand near the base of shale series, northeast of Punto Mero, Peru." G. C. Gester, Coll.

333. "Cliff near base of shale series, northeast of Punto Mero, Peru." G. C. Gester, Coll. No. 18.

334. "From sandy shale at Punto Sal Chico, Peru; dip. 25°-30° North." G. C. Gester, Coll.

335. "Punto Sal Chico, Peru." G. C. Gester, Coll.

336. "Near base of organic shale series at Quebrada, northeast of Moss Peak, Peru." G. C. Gester, Coll.

338. "Cliffs of Punto Giganta, Peru." G. C. Gester, Coll.

339. "Halfway up sea cliff, midway between Boca Pan and Sechunta, or about one mile northeast of Boca Pan, Peru." G. C. Gester, Coll.

340. "Near top of sea cliff one-fourth mile southwest of Eloisa, nearly one mile southwest of Boca Pan camp, Peru." G. C. Gester, Coll. No. 2.

341. "On a hill just a little southwest of Giganta Quebrada, Boca Pan, Peru." G. C. Gester, Coll. No. 3.

342. "South side and one mile from entrance of Culebra Orá, Peru." G. C. Gester, Coll.

[4] Letter dated January 14, 1925, from M. L Raney, Librarian, Johns Hopkins University to Dr. Barton W. Evermann, on file at the California Academy of Sciences.

[5] Letter dated January 13, 1925, from Anne M. Collins, Mail Order Department, the Macmillan Company, to Dr. Barton W. Evermann, on file at the California Academy of Sciences.

[6] All numbers refer to the catalog of the Department of Paleontology, California Academy of Sciences.

343. "One to one-and-a-fourth miles north of des embarcadero, Culebra, Ora, Peru." G. C. Gester, Coll.

344. "Near top of cliff, above No. 339, midway between Boca Pan and Sechunta, Peru." G. C. Gester, Coll.

345. "Negritos, Peru; one-fourth mile from camp." G. C. Gester, Coll.

346. "Low cliff, near base, just north of Piedros Redondas, Peru." G. C. Gester, Coll.

555. "Cavacha de Conchas, on sea cliff one mile west of Payta, Peru." G. C. Gester, Coll. No. 4.

556. "One-fourth mile southwest of Eloisa, or nearly one mile southwest of Boca Pan Well No. 2, Peru." G. C. Gester, Coll. No. 2. (Same locality as 340, above.)

850. "Quebrada Mancora, Peru; from transition beds between Heath shales and Trigal sandstone." Arthur May, Coll. No. 5.

851. "Mouth of Quebrada Mancora, northern Peru; from same horizon as No. 850." Arthur May, Coll. No. 6.

852. "One mile east of Boca de Quebrada Mancora, Peru; near base of Heath shale." Arthur May, Coll. No. 8.

853. "Bluff at beach on south side of Caleta Sal, Peru; transition zone between Heath shale and Trigal sandstone." Arthur May, Coll. No. 10.

854. "El Convento (near La Breita) Peru; Carnoas shale." Arthur May, Coll. No. 11.

855. "Massive white sandstone at Cabo Blanco, Peru." Arthur May, Coll. No. 16.

856. "At beach one mile north of Negritos, Peru; Parinas sandstone of Bosworth." Arthur May, Coll. No. 17.

857. "From the lower beds of the Upper Zorritos, Quebrada Boca Pan, Peru." Arthur May, Coll. No. 18.

858. "Lower Zorritos formation at the head of Quebrada Heath, Peru." Arthur May, Coll. No. 19.

861. "Turritella beds of the Negritos region, Peru." Arthur May, Coll. No. 25.

862. "Middle sandy Heath formation at Cerro Marinero, Peru." Arthur May, Coll. No. 26.

Description of Species

The two collections studied contain a few species which appear to be undescribed up to this time and a few others, already described, but for which additional important characters are shown. These are here taken up in detail.

1. **Turritella conquistadorana** Hanna & Israelsky, new species

Plate 7, figure 5

Shell acute-conic, with an apical angle of 15°; suture depressed, with a strong collar-like rib just below; three less prominent primary ribs below the collar and with minor riblets intercalated. Altitude 23.7 mm. (apex missing); diameter 5.1 mm.

Type: No. 1707, Mus. Calif. Acad. Sci. from locality No. 850 (C.A.S. coll.) "**Quebrada Mancora, Peru,** Eocene;" Arthur May, coll.

The new species resembles *Turritella humerosa* Conrad[7] in general type of sculpture and apical angle, but has a much more pronounced carina and fewer primary ribs. The ribs on *Turritella merriami* Dickerson[8] are much finer than on the new species.

2. **Turritella cochleiformis** Gabb

Plate 7, figures 6 and 7

Turritella cochleiformis GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 29. —Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, figs. 7, 7a.

The figured specimens, Nos. 1708 and 1709 (C.A.S. coll.) came from locality No. 555 (C.A.S. coll.), "Cavacha de las Conchas, one mile west of Payta, Peru, on sea cliff." G. C. Gester, coll. It is believed that these show the characters of the species better than the original drawing.

3. **Turritella filicincta varicosta** Spieker

Plate 8, figure 6

Turritella filicincta var. *varicosta* SPIEKER, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 66, pl. 3, fig. 3.

Opportunity is taken to illustrate the aperture of this variation and to show the heavy callosity of the inner lip. The

[7] Maryland Geol. Surv. Eocene, p. 148, pl. 27, figs. 1, 1a, Baltimore, Johns Hopkins Press, 1901.
[8] Dickerson, Univ. Calif. Publ. Bull. Dept. Geol., Vol. 7, No. 12, 1913, p. 284, pl. 13, figs. 6a, 6b, 6c.

specimen figured, No. 1710 (C.A.S. coll.), is from locality No. 328 (C.A.S. coll.), "near top of a small hill south of Corona Peak, Peru." G. C. Gester, coll.

4. **Faunus paytensis** (Woods)

Plate 8, figure 8

"Cerithium" paytensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 87, pl. 10, figs. 7-9.

The specimen here illustrated has a strong callosity on the inner lip which shows the species should probably be placed in the genus Faunus. The specimen figured, No. 1711 (C.A.S. coll.), is from locality No. 555 (C.A.S. coll.), "Cavacha de las Conchas, one mile west of Payta, Peru, on sea cliff." G. C. Gester, coll.

5. **Melanatria (?) gesteri** Hanna & Israelsky, new species

Plate 8, figures 1-3

Shell, robust, spire turreted, composed of eight post-nuclear whorls; sutures deeply impressed, bordered above and below by an irregular, rounded, spiral, ridge; body whorl with these two ridges and three smaller ones below; the uppermost of the three shows above the suture on the penultimate whorl; columella twisted, and apparently heavily calloused in full-grown specimens; these (No. 1712, C.A.S. coll.) have a decided anal sulcus in the upper angle of the aperture; peristome thin; canal of moderate length only.

Measurements in millimeters

Number	Length	Diameter
1712	64.5±5	27.5
1713	52±10	27.0
1714	55±5	26.8

Cotypes: Nos. 1712, 1713, 1714, Mus. Calif. Acad. Sci., from Loc. 334 (C.A.S. coll.) "Punta Sal Chico. Peru; Negritos [Eocene] formation;" G. C. Gester, coll.

The series of specimens available for study shows considerable variation, as would be expected in this, presumably a brackish-water inhabiting genus. The depth of the impression of the suture and the coarseness of the spiral ridges seem to be

most subject to variation of all the shell characters and the three specimens chosen for cotypes were selected to illustrate these points. There is no trace of spines on the spire such as are found in *Pseudoglauconia lissoni* from the same formation.

It is not certain that these large shells belong to the genus *Melanatria* Bowdich, the type of which appears to have been a spineless species; but for want of a genus where they can be placed with greater positiveness it seems that this is as satisfactory disposition of them as can be made at present.

The species is named for Mr. G. C. Gester, whose field work has greatly enriched the collections of the California Academy of Sciences.

6. **Siphonalia phosoidea** Hanna & Israelsky, new species

Plate 7, figure 10; plate 8, figures 5, 7

Shell fusiform, ventricose, with apical angle of 38°, gently shouldered, with short open canal; sculpture consisting of numerous, nearly equally spaced spiral liræ, those on the base being coarser than the others; where crossed by growth lines nodules are formed; axial sculpture consisting of slightly oblique ribs which become strongest at shoulder where they form nodes (seven on body whorl); suture slightly raised, undulating; aperture elliptical, produced anteriorly into a short open siphonal canal; columella somewhat twisted; altitude 45.4 mm. (spire and canal broken); diameter 21 mm.

Type: No. 1716, Mus. Calif. Acad. Sci., from locality No. 328 (C.A.S. coll.) "**near top of small hill south of Corona Peak, Peru**; Zorritos formation;" G. C. Gester, coll.

Paratype: No. 1717, Mus. Calif. Acad. Sci., from locality 336 (C.A.S. coll.), from near base of organic shale series, "**Quebrada northeast of Moss Peak, Peru**;" Zorritos formation; G. C. Gester, coll.

We have been unable to find any closely related species with which to compare this fossil. It is placed in the genus *Siphonalia,* using that name in the broad sense in which western paleontologists have given it; if present tendencies in nomenclature persist, the species inevitably, will be placed in another group.

7. **Clavilithes(?) atahuallpai** Hanna & Israelsky, new species

Plate 7, figures 8 and 9

Shell fusoid, with body whorl longer than turreted spire; ornamented by fine spiral lines, which become rather heavy on base of body whorl; spire with apical angle of 70° and strongly noded, the body whorl slightly noded or not at all; shoulder tabulate for about 1½ whorls from aperture; aperture suboval, inclined, notched at shoulder; anterior canal open, narrow, curved, about same length as body whorl; columella vertical, flexuous; inner lip slightly calloused; umbilicus incipient; measurements of type, No. 1718: altitude 41.9 mm. (apex broken); diameter 24 mm.

Type: No. 1718, *paratype* No. 1719, Mus. Calif. Acad. Sci., from locality No. 339, "**near top of a small hill south of Corona Peak, Peru**; Zorritos formation;" G. C. Gester, coll.

The species has a surprising resemblance to *Macron philadelphicus* Harris[9]. As the nuclear portion of the shell is missing, the true systematic position is not known. Furthermore, certain of the characters appear fasciolaroid and the species may belong to an undescribed genus.

The species is named for Atahuallpa, the last chief of the Incas.

8. **Clavilithes burtti** Hanna & Israelsky, new species

Plate 7, figure 11

Shell broadly fusiform, heavy, early whorls strongly lirate, later ones weakly lirate; growth lines distinct; spire short; whorls sharply keeled at periphery; shoulder flat, inclined outward; suture deeply impressed; aperture ovate, opening into an open, narrow anterior canal; inner lip strongly calloused; columella nearly straight, smooth; altitude 63.4 mm., (spire and canal broken); diameter 37.3 mm.

Type: No. 1720, Mus. Calif. Acad. Sci., from locality No. 850 (C.A.S. coll.) from "**Quebrada Mancora, Peru**; Eocene;" Arthur May, coll.

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[9] Harris, Bull. 11, Vol. 3, Amer. Paleont., pl. 7, fig. 8.

This species may readily be distinguished from those described by Woods by its much shorter spire.

Named for Mr. John G. Burtt of the Shell Oil Company, of California, through whose efforts a considerable number of specimens were received for this study.

9. "**Surcula**" **mayi** Hanna & Israelsky, new species

Plate 7, figure 12

Shell thick, broadly fusiform; apical angle 70°; spire less than half as high as body whorl; whorls sharply angulated; fine spiral striations over whole of shell; strong nodes occur on angulation of whorls; 15 on body whorl; shoulder somewhat concave; growth lines indistinct on type; aperture ovate; inner lip heavily calloused; a low, rounded, elongated tooth is present on the columella near the upper termination of the peristome, thus resembling many members of the family Bursidæ; canal of moderate length, slightly twisted. Altitude 62.9 mm. (spire and canal broken); diameter 38 mm.

Type: No. 1721, Mus. Calif. Acad. Sci. from locality No. 850 (C.A.S. coll.) from "**Quebrada Mancora, Peru**; Eocene;" Arthur May, coll.

This species can readily be distinguished from *Surcula thompsoni* WOODS[10] by its greater apical angle and more numerous tubercles and from *Surcula occidentalis* Woods[11] by its relatively lower spire and greater angulation of the whorls.

The species is named for Mr. Arthur May, who collected it and several of the other forms described herein.

In accordance with present-day usage we have placed this large shell in the genus *Surcula,* although with a feeling that if generic discrimination continues in the future as it has of late years it must inevitably be transferred to some other group; typically, *Surcula* is a very different organism[12].

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[10] Woods, in Bosworth, Geology of N.W. Peru, Macmillan & Co., London, 1922, pl. 17, figs. 1, 2, 3.

[11] Op. Cit., pl. 16, figs. 7, 8, 9, 10.

[12] See in this connection Anderson & Hanna, Fauna of the Type Tejon Eocene, Occ. Pprs. 11, Calif. Acad. Sci., 1925, p. 82.

10. **Natica coronis** Hanna & Israelsky, new species

Plate 8, figure 4

Spire very high, composed of 5½ whorls which are evenly rounded and symmetrical; umbilicus partially open; parietal wall covered with a greatly thickened callous deposit; suture not deeply impressed. Altitude 34 mm. (originally about 38 mm.); diameter 25 mm.

Type: No. 1715, Mus. Calif. Acad. Sci., from Loc. 328 (C.A.S. coll.) "**near the top of a small hill on the south side of Corona Peak, Peru**; Zorritos formation;" G. C. Gester, coll.

The exceedingly high spire of this species has made it impossible to identify it with any of those previously described from the region. It has a still higher spire than *Natica subclausa* Sowerby[13], a very common and well known species from the Miocene of Santo Domingo, Gatun, Colombia and elsewhere.

11. **Crassatellites pizarroi** Hanna & Israelsky, new species

Plate 7, figure 1

Shell medium in size, ledaeform, ornamentation consisting of concentric ribbing and deep, well defined lunule; escutcheon present; beaks depressed; anterior end of shell well rounded, posterior elongated; length 36.4 mm.; height 22 mm.; thickness 13.2 mm.

Type: No. 1722, Mus. Calif. Acad. Sci., from locality 858 (C.A.S. coll.) "**head of Quebrada Heath, Peru**; Zorritos formation, Miocene;" Arthur May, coll.

The species is named for Francis Pizarro, the Spanish conqueror of Peru. It resembles in a general way *C. berryi* Spieker from the same formation, but lacks the very conspicuous concentric sculpture and the posterior angulation of that species.

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[13] Quart. Journ. Geol. Soc., Vol. 6, 1849, p. 51. See Maury, Bull. 29, Am. Paleo., 1917, p. 136, pl. 23, fig. 14, for bibliographic references and notes.

12. **Macrocallista cavachana** Hanna & Israelsky, new species

Plate 7, figure 3

Shell small, ovate, very inequilateral; beak situated about one-fourth the distance from the anterior end, incurved and prosogyrous; dorsal slopes steep, basal margin broadly rounded; lunule flat, not deeply circumscribed; escutcheon not well defined; sculpture consisting of fine, concentric striæ only; hinge plate narrow, not well preserved in type; length 23.5 mm.; height 17.3 mm.; thickness, (1 valve) 5.7 mm.

Type: No. 1723, Mus. Calif. Acad. Sci., from locality No. 555 (C.A.S. coll.) "**Cavacha de las Conchas, one mile west of Payta, Peru,** on sea-cliff; Eocene;" G. C. Gester, coll.

The new species resembles in outline *Macrocallista helenæ* Spieker[14], from the Zorritos, but lacks the comparatively heavy ribbing of that species.

13. **Chione sechuntana** Hanna & Israelsky, new species

Plate 7, figure 2

Shell small, ovate-cordiform, sub-trigonal, gibbose, radiately and concentrically ribbed; beaks prominent, inflated, incurved and directed forward, situated about a third the distance from the anterior end; anterior end short, convex; posterior slope nearly straight along hinge line; basal margin gently rounded, slightly notched posteriorly due to slight flexuosity; lunule round, well defined; escutcheon short and broad; length 21.5 mm.; height 19 mm.; diameter 15.7 mm.

Type: No. 1724, Mus. Calif. Acad. Sci., from locality No. 339 (C.A.S. coll.) "sea cliff, **halfway between Boca Pan and Sechunta, one mile northeast of Boca Pan, Peru**; Zorritos formation;" G. C. Gester, coll.

14. **Corbula woodsi** Hanna & Israelsky, new species

Plate 7, figure 4

Shell subtrigonal, inequivalve, the left being the larger; inequilateral, gibbose, sharply angled behind; strongly and concentrically striated; beaks prominent, the right being a little the

[14] Spieker, Johns Hopkins Univ., Studies in Geology No. 3, Baltimore, 1922, p. 145, pl. 9, figs. 3, 4.

higher; both twisted inwardly and slightly forward; lunule not well defined; escutcheon long, broadly elliptical; a very deep channel, posterior to the beak tends to form a rostrum; length 17 mm.; height 13 mm.; diameter 10.1 mm.

Type: No. 1725, Mus. Calif. Acad. Sci., from Loc. No. 555 (C.A.S. coll.) "**Cavacha de las Conchas, one mile west of Payta, Peru**; on sea-cliff; Eocene;" G. C. Gester, coll.

Named for Dr. Henry Woods, the eminent English paleontologist, in recognition of his work on the paleontology of Peru.

It is recognized that in the deep posterior channel this shell departs from the usual Corbula-form, but we have not been able to place it with certainty in any other group.

Checklist of Species of Peruvian Tertiary Paleontology

In the following checklist names of genera and species are arranged alphabetically as used by the various authors. Cross references to changes in nomenclature are supplied. In the preparation of the list it has been found that several Peruvian species have been given specific names which were not valid according to the rules of nomenclature in current use and these have been renamed herein. No attempt has been made to correct the genus-names except in those cases where the species have been considered in the foregoing part of this paper, or in the identification of the two collections concerned.

The following is a list of new names proposed:

Ampullina woodsi
Clavilithes atahuallpai
Clavilithes burtti
Columbella paytana
Fusus talaraensis
Melanatria gesteri
Natica coronis
Siphonalia phosoidea
Surcula mayi
Terebra nelsoni
Turritella conquistadorana
Turritella supraconcava
Area retractata
Çardium spiekeri
Chione sechuntana
Corbula talarana
Crassatellites pizarroi
Lucina talarana
Macrocallista cavachana
Pecten incus
Corbula woodsi

GASTROPODA

Ampullina gabbi WOODS. See *Ampullina woodsi* HANNA & ISRAELSKY, new name.

Ampullina ortoni GABB, Amer. Journ. Conch. Vol. 5, 1869, p. 27; Payta, Peru; Tertiary.—GABB, Journ. Acad. Nat. Sci. Phila. Vol. 8, ser. 2, 1878, p. 264, pl. 35, fig. 3; *(Euspira)*. [Loc. 555, C.A.S. coll.]

Ampullina paytensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 77, pl. 7, figs. 3, 4. Lobitos Formation, Eocene.

Ampullina woodsi HANNA & ISRAELSKY, new name. [Loc. 335, C.A.S. coll.]
Ampullina gabbi WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 77, pl. 7, fig. 2. Negritos Formation, Eocene.
Not *Natica (Ampullina) gabbi* CLARK, Univ. Calif. Publ. Geol. Vol. 11, 1917, p. 166, pl. 19, figs. 12, 14, 15; San Lorenzo Oligocene, California.

Aphera peruana NELSON. See *Cancellaria peruana* (NELSON).

Argobuccinum zorritense NELSON. See *Nassa zorritensis* (NELSON).

Bezauconia pupoidea WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 89, pl. 11, figs. 6-8. Negritos Formation, Eocene.

Bulla sp. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 186, not. fig'd. Zorritos, Peru.

Calliostoma noduliferum NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 187, pl. 6, fig. 1. Zorritos, Peru.
Calliostoma (Eutrochus) noduliferum NELSON, SPIEKER, Pal. Zorritos Form., Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 92, pl. 1, figs. 7, 8. Zorritos Formation, Miocene. [Loc. 556, C.A.S. coll.]

Cancellaria bradleyi NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1. 1870, p. 192, pl. 6, figs. 8, 9. Zorritos, Peru.

Cancellaria larkinii NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 192, pl. 6, fig. 7. Zorritos, Peru.

Cancellaria (Aphera) peruana (NELSON), SPIEKER, Paleontology of the Zorritos Formation Johns Hopkins Univ. Studies in Geology No. 3, p. 42, pl. 4, fig. 13. Zorritos Formation, Miocene.
Aphera peruana NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 190, pl. 6, fig. 3. Zorritos, Peru.

Cancellaria spatiosa NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 191, not fig'd. Zorritos, Peru.

Cancellaria triangularis NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 191, pl. 6, fig. 10. Zorritos, Peru.

Cerithium chatwini WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 88, pl. 11, figs. 3-5. Negritos Formation, Eocene.

Cerithium grillanum SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 57, pl. 2, fig. 10. Zorritos Formation, Miocene.

Cerithium infranodatum SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 56, pl. 2, fig. 9. Upper Zorritos Formation, Miocene.

Cerithium læviusculum GABB, Amer. Jour. Conch. Vol. 5, 1896, p. 27, Payta, Peru, Tertiary.—GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, fig. 4.

Cerithium negritosense WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 87, pl. 11, figs. 1, 2. Negritos Formation, Eocene.

"Cerithium" paytense WOODS. See *Faunus paytensis* (WOODS).

Clavella solida NELSON. See *Triumphus solida* (SPIEKER).

"Clavilithes" atahuallpai HANNA & ISRAELSKY, this paper, p. 44, pl. 7, figs. 8, 9, Zorritos Formation, Miocene.

Clavilithes burtti HANNA & ISRAELSKY, this paper, p. 44, pl. 7, fig. 11. Eocene.

Clavilithes harrisi WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 97, pl. 13, figs. 5, 6. Negritos and Lobitos Formations, Eocene.

Clavilithes incertus WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 100, pl. 14, fig. 3. Negritos Formation, (var. ? in Lobitos), Eocene.

Clavilithes pacificus WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 99, pl. 13, fig. 10; pl. 14, figs. 1, 2. Negritos and Lower Lobitos Formations, Eocene. [Loc. 850, C.A.S. coll.]

Clavilithes peruvianus WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 98, pl. 13, figs. 7-9. Negritos and Lobitos Formations, Eocene.

Columbella buccata GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 647, pl. 19, fig. 7. Talara Formation, Miocene.

Columbella longistoma GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 648, pl. 19, fig. 9. Talara Formation, Miocene.

Columbella paytana HANNA & ISRAELSKY, new name.

Columbella turrita GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 648, pl. 19, fig. 11. Talara Formation, Miocene.

Not *Columbella turrita* SOWERBY, Proc. Zool. Soc. London, 1832, p. 115.

Columbella turrita GRZYBOWSKI. See *Columbella paytana* HANNA & ISRAELSKY, new name.

Conus berryi SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 39, pl. 1, fig. 4. Lower Zorritos Formation, Miocene.

Conus bocapanensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 38, pl. 1, fig. 3, Lower Zorritos Formation, Miocene.
Conus sp. ind., A. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 194, not fig'd. Zorritos, Peru.

Conus cacuminatus SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 40, pl. 1, fig. 5. Upper Zorritos (?) Formation, Miocene.
Conus sp. ind., B, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 194, not fig'd. Zorritos, Peru.

Conus molis var. *bravoi* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 2, 1922, p. 41, pl. 1, fig. 6. Upper Zorritos Formation, Miocene.
Conus sp. ind., C. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 194, not fig'd. Zorritos, Peru.

Conus multiliratus var. *gaza* JOHNSON & PILSBRY, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology No. 3, 1922, p. 37. Lower Zorritos Formation, Miocene.

Conus (Lithoconus) sp. WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 108. Lobitos Formation, Eocene.

Conus, sp. ind. A, NELSON. See *Conus bocapanensis* SPIEKER.

Conus, sp. ind. B, NELSON. See *Conus cacuminatus* SPIEKER.

Conus, sp. ind. C, NELSON. See *Conus molis bravoi* SPIEKER.

Crepidula, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 187, not fig'd. Zorritos, Peru.

Crucibulum inerme NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 188, not fig'd. Zorritos, Peru.

Cuma alternata NELSON. See *Solenosteira alternata* (NELSON).

Cypræa angustirima SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 55, pl. 2, figs. 7, 8. Lower Zorritos Formation, Miocene.

Diastoma americanum WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 92, pl. 12, figs. 1, 2. Negritos Formation, Eocene.

Dientomochilus (Ectinochilus) cf. *laqueata* (CONRAD), WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 92, pl. 12, fig. 3. Lobitos Formation, Eocene.

Dolium (Malea) camura (GUPPY), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 52. Zorritos Formation, Miocene.

Dolium (Malea) sp. indet., SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology No. 3, 1922, p. 53. Variegated Zorritos, Miocene.

Eovasum peruvianum DOUVILLE, Journ. de Conch. Vol. 66, 1921, p. 4, pl. 1, figs. 4a, 4b, 5. [Eocene], Peru.

Faunus (?) *lagunitensis* WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 86, pl. 10, figs. 4-6. Lobitos Formation, Eocene.

Faunus paytensis (WOODS).
"*Cerithium*" *paytense* WOODS, in BOSWORTH, Geology of Northwest Peru, 1922, p. 87, pl. 10, figs. 7-9. Lobitos Formation, Eocene.
Faunus paytense (WOODS), HANNA & ISRAELSKY, this paper, p. 42, pl. 8, fig. 8. [Locs. 555, 854, C.A.S. coll.]

Fusus inflatus GRZYBOWSKI. See *Fusus talaraensis* HANNA & ISRAELSKY, new name.

Fusus paytensis GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 25.—GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, figs. 1, 1a. Tertiary, Payta, Peru.

Fusus talaraensis HANNA & ISRAELSKY, new name.
Fusus inflatus GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 648, pl. 19, fig. 5. Talara Formation, Miocene.
Not *Fusus inflatus* DUNKER, PHILIPPI, Abbild. u. Beschr. Conch., Vol. 2, 1842-1851, p. 19, pl. 4, fig. 3.
(Several times otherwise preoccupied.)

Littorina laqueata GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 28. Tertiary, Payta, Peru.—GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, fig. 5.

Malea, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, 1870, pt. 1, p. 196, not fig'd. Zorritos, Peru.

Marginella incrassata NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 197, pl. 6, figs. 5, 6. Zorritos, Peru.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 43, pl. 1, fig. 9. Zorritos Formation, Miocene.

Melanatria acanthica WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 84, pl. 9, figs. 12-14. Negritos Formation, Eocene.

Melanatria dimorphica WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 83, pl. 9, fig. 11. Negritos Formation, Eocene.

Melanatria gesteri HANNA & ISRAELSKY, new species; this report, p. 42.

Melanatria propinqua WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 85, pl. 10, fig. 1. Negritos Formation, Eocene.

Melanatria venusta WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 85, pl. 10, fig. 2. Negritos Formation, Eocene.

Mitra, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 197, not fig'd. Zorritos, Peru.

Mitra labiata[15] GRZYBOWSKI, Neues Jahrbuch für Min., Geol., Pal., Bl. Bd. 12, 1899, p. 649, pl. 19, fig. 10. Talara Formation, Miocene.

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[15] COSSMANN & PISSARO, Iconograph, 1907-1913, Vol. 2, pl. 42, figs. 202-210, illustrate a species from the Eocene of the Paris Basin which they call *Mitra (Mitreola) labiata* (CHEMNITZ). In the limited time available for search it has not been possible to ascertain whether Grzybowski's name for the Peruvian fossil conflicts with this one or not.

Morgania costata WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 83, pl. 9, figs. 7-10. Negritos Formations, Eocene.

Morgania magna WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 82, pl. 9, figs. 5, 6. Negritos Formation (probably also Lower Lobitos), Eocene.

Murex laqueoratus SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 51, pl. 2, fig. 4. Zorritos Formation, Miocene.

Myurella tuberosa NELSON. See *Terebra nelsoni* HANNA & ISRAELSKY, new name.

Myurella, sp. ind. A, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 193, not fig'd. Zorritos, Peru.

Myurella, sp. ind. B, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 193, not fig'd. Zorritos, Peru.

Nassa lagunitensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 95, pl. 12, fig. 12, pl. 13, fig. 1. Lobitos Formation, Eocene. [Loc. 850, C.A.S. coll.]

Nassa zorritensis (NELSON), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 48, pl. 2, figs. 1, 2. Variegated Zorritos Formation, Miocene. *Argobuccinum zorritense* NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 196, pl. 7, figs. 1, 2. Zorritos, Peru.

Natica coronis HANNA & ISRAELSKY, new species, this paper, p. 46, pl. 8, fig. 4. Zorritos.

Natica elata GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 642, pl. 20, fig. 8. Talara Formation, Miocene.

Natica (Naticina) sp. WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 77, pl. 6, fig. 9; pl. 7, fig. 1. Lobitos Formation, Eocene.

Oliva, sp. ind., A, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 197, not fig'd. Zorritos, Peru.

Oliva, sp. ind., B, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 197, not fig'd. Zorritos, Peru.

Olivancillaria eocenica WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 105, pl. 16, figs. 3, 4. Negritos Formation, Eocene.

Olivancillaria (Agaronia) peruviana WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 106, pl. 16, figs. 5, 6. Lobitos Formation, Eocene. [Loc. 328, C.A.S. coll.]

Phos (?) *latirugatus* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies Geology, No. 3, 1922, p. 46, pl. 1, fig. 12. Lower Zorritos, Miocene.

Pirena peruviana DOUVILLÉ, Journ. de Conch. Vol. 66, 1921, p. 11, pl. 2, fig. 3 [Eocene], Peru. [In the explanation of the plate, the name *peruviana* is given as a race of *P. vellicata* Bellardi.]

Pleurotoma, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 194, not fig'd. Zorritos, Peru.

Polinices porcana SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, p. 88, pl. 4, fig. 9. Lower Zorritos Formation, Miocene.

Polinices subangulata NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 195, pl. 6, figs. 4, 12, 13. Zorritos, Peru.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 87, pl. 4, fig. 8. Lower Zorritos and Variegated Formations, Miocene.

Potamides occidentalis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 90, pl. 11, fig. 19. Negritos Formation, Eocene. [Loc. 857, C.A.S. coll.]

Potamides ormei var. *infraliratus* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 58, pl. 2, fig. 11. Lower and Upper Zorritos Formations, Miocene. [Locs. 329, 338, C.A.S. coll.]

Pseudoglauconia lissoni DOUVILLÉ, Journ. Conchyl. Vol. 66, 1921, pp. 8, 9, fig. 1, pl. 2, fig. 1. [Eocene], Peru.
WOODS in BOSWORTH, Geology of Northwestern Peru, 1922, p. 85, pl. 10, fig. 3. Negritos Formation, possibly Lower Lobitos, Eocene. [Loc. 857, C.A.S. coll.]

Pseudoliva mutabilis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 94, pl. 12, figs. 7-11. Negritos Formation, Eocene. [Loc. 331, C.A.S. coll.]

Pseudoliva parinasensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 93, pl. 12, figs. 4, 6. Negritos and Lobitos Formations, Eocene. [Loc. 333, C.A.S. coll.]

Puncturella phrygia GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 642, pl. 20, figs. 12, 12a. Zorritos, Miocene.

Purpura chocolatum DUCLOS, GABB, Am. Journ. Conch., Vol. 5, 1869, p. 26, Payta, Peru, Tertiary.

Pyrula peruviana SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies Geology, No. 3, 1922, p. 54, pl. 2, figs. 5, 6. Zorritos Formation, Miocene.

Pyrula roseta GRZYBOWSKI. See *Triumphis solida* (NELSON).

Sigaretus excentricus GUPPY, GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 643, pl. 20, fig. 9. Talara Formation, Miocene.

Sinum coralanum SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 89, pl. 4, fig. 10. Lower Zorritos Formation, Miocene. [Loc. 331, C.A.S. coll.]

Siphonalia phosoidea HANNA & ISRAELSKY, new species this paper, p. 43, pl. 7, fig. 10, pl. 8, figs. 5, 7. Zorritos Formation, Miocene.

Solarium nelsoni WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 76, pl. 6, figs. 6-8. Negritos Formation, Eocene.

Solarium sexlineare NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 194, pl. 6, fig. 11. Zorritos, Peru.—GRZYBOWSKI, Neues Jahrbuch für Min. Geol. Pal. Bl. Bd. 12, 1899, p. 642 (name spelled "sexlineatum" p. 655.), pl. 20, fig. 13. Zorritos Formation, Miocene.—WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 109, pl. 18, fig. 1. Zorritos Formation, Miocene.

Solenosteira alternata (NELSON) SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 45, pl. 1, figs. 10, 11. Lower Zorritos Formation, Miocene.
Cuma alternata NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 198, pl. 7, figs. 3, 4. Zorritos, Peru.

Strepsidura pacifica WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 96, pl. 13, figs. 2-4. Negritos and Lower Lobitos Formations, Eocene.

Strombina lanceolata (SOWERBY), NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 198. Zorritos, Peru.

Strombus furcatus GRZYBOWSKI, Neues Jahrbuch fur Min. Geol. Pal. Bl. Bd. 12, 1899, pl. 20, figs. 14, 14a. Talara Formation, Miocene.

Strombus, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 192. Zorritos, Peru.

Struthiolaria guttifera GRZYBOWSKI, Neues Jahrb. fur Min. Geol. Pal. Bl. Bd. 12, 1899, p. 647, pl. 19, fig. 8. Zorritos Formation, Miocene.

"Surcula" mayi HANNA & ISRAELSKY, new species, this paper, p. 45, pl. 7, fig. 12. Eocene.

Surcula occidentalis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 106, pl. 16, figs. 7-10. Negritos Formation, Eocene.

Surcula thompsoni WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 107, pl. 17, figs. 1, 2. Negritos Formation, Eocene.

Sycum americanum WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 101, pl. 14, fig. 4. Negritos Formation, Eocene.

Telescopium peruvianum WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 91, pl. 11, figs. 13, 14. Lobitos Formation, Eocene.

Terebra gausapata var. *herviderana* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 35, pl. 1, fig. 1. Lower Zorritos Formation, Miocene.

Terebra nelsoni HANNA & ISRAELSKY, new name.
Myurella tuberosa NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 193, not fig'd.
Terebra tuberosa (NELSON), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 36, pl. 1, fig. 2. Zorritos Formation, Miocene.
Not *Terebra tuberosa* HINDS, Proc. Zool. Soc. London, 1843, p. 152.

Terebra tuberosa (Nelson). See *Terebra nelsoni* Hanna & Israelsky, new name.

Tritonium pernodosum Gabb, Amer. Journ. Conch., Vol. 5, 1869, p. 26, Tertiary, Payta, Peru.—Gabb, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, fig. 2.

Triumphis solida (Nelson), Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies Geology, No. 3, 1922, p. 49, pl. 2, fig. 3. Lower Zorritos Formation, Miocene. [Loc. 328, C.A.S. coll.]

Clavella solida Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 199, not figured. Zorritos, Peru.

Pyrula roseta Grzybowski, Neues Jahrb. Min. Geol. Pal. Bl. Bd. 12, 1899, p. 648, pl. 19, fig. 6. Zorritos Formation.

Turbo belli Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 91, pl. 4, fig. 11. Zorritos Formation, Miocene.

Collopoma lineatum Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 187, pl. 6, fig. 2. Zorritos, Peru.

Not *Turbo lineatus* Da Costa, Brit. Conch. 1778, p. 100.

Turbo belli var. *æquifilicatum* Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 92, pl. 4, fig. 12. Lower Zorritos Formation, Miocene.

Turritella sp. cf. *altilira* Conrad, Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 110, pl. 19, figs. 2-4. Zorritos Formation, Miocene.

Turritella altilira Conrad, Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 59, pl. 2, fig. 12. Lower Zorritos Formation, Miocene. [Loc. 858, C.A.S. coll.]

Turritella altilirata Conrad, Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 645, pl. 20, fig. 7. (Spelled *altilirata* after Gabb, Journ. Acad. Nat. Sci. Phila., 1877, p. 341, pl. 44, figs. 9, 9a.) Zorritos Formation, Miocene. [See *Turritella altilira* Conrad.]

Turritella alturana Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 62, pl. 2, fig. 13 (reads 3 in text). Horizon unknown.

Turritella plana Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 188, not fig'd. Zorritos, Peru.

Not *Turritella plana,* McCoy or Brinkhorst, 1861.

Turritella anceps Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 81, pl. 8, figs. 12, 13; pl. 9, figs. 1, 2. Negritos Formation, Eocene. [Loc. 856, C.A.S. coll.]

Turritella annectens Woods, in Bosworth, Geology of Northwest Peru, 1922, p. 81, pl. 9, figs. 3, 4. Negritos and Lobitos Formations, Eocene.

Turritella bifastigata NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 189, not fig'd. Zorritos, Peru.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies Geology, No. 3, 1922, p. 63, pl. 3, fig. 1. Upper Zorritos Formation, Miocene. [Loc. 329, C.A.S. coll.]

Turritella bosworthi WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 80, pl. 8, figs. 8-10. Negritos Formation, Eocene. [Loc. 855, C.A.S. coll.]

Turritella charana SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 86, pl. 4, fig. 7. Lower Zorritos Formation, Miocene. [Loc. 338, C.A.S. coll.]

Turritella cochleiformis GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 29, Payta, Peru, Tertiary.—GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, figs. 7, 7a. [Loc. 555, C.A.S. coll.]

Turritella conquistadorana HANNA & ISRAELSKY, new species, this paper, p. 41, pl. 7, fig. 5, Eocene.

Turritella dickersoni WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 79, pl. 8, figs. 6, 7. Negritos Formation, Eocene. [Loc. 850, C.A.S. coll.]

Turritella douvillei WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 80, pl. 8, fig. 11. Negritos Formation, Eocene.

Turritella (Haustator) filicincta GRZYBOWSKI, Neues Jahrbuch Min. Geol. Pal. Bl. Bd. 12, p. 645, pl. 20, fig. 2. Heath Formation, Miocene.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 65, pl. 3, fig. 2. Lower Zorritos Formation, Miocene.

Turritella filicincta var. *varicosta* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 66, pl. 3, fig. 3. Lower Zorritos Formation, Miocene. [Locs. 328, 556, C.A.S. coll.]

Turritella (Haustator) gabbiana GRZYBOWSKI, Neues Jahrb. Min. Geol. Pal. Bl. Bd. 12, 1899, p. 646, pl. 20, fig. 11. Zorritos Formation, Miocene.

Turritella gothica GRZYBOWSKI, Neues Jahrbuch Min. Geol. Pal. Bl. Bd. 12, 1899, p. 645, pl. 20, fig. 10. Zorritos Formation, Miocene.—WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 110. Zorritos Formation, Miocene. [Loc. 329, C.A.S. coll.]

Turritella inca GRZYBOWSKI, Neues Jarhb. Min Geol. Pal. Bl. Bd. 12, p. 644, pl. 20, fig. 1. Zorritos Formation, Miocene.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 73. Upper Zorritos or Variegated Formation, Miocene.

Turritella inca var.. *trita* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 73, pl. 3, fig. 4. Upper Zorritos Formation, Miocene.

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Turritella inconspicua GRZYBOWSKI. See *Turritella prenuncia* var. *inconspicua* GRZY.

Turritella infracarinata GRZYBOWSKI, Neues Jahrbuch Min. Geol. Pal. Bl. Bd. 12, 1899, p. 643, pl. 20, fig. 5. Zorritos Formation, Miocene.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 79, pl. 3, figs. 9, 10. Upper Zorritos Formation, Miocene. [Loc. 333, C.A.S. coll.]

Not *Turritella infracarinata* GRZYBOWSKI, WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 109, pl. 18, figs. 2, 3. See *T. nelsoni* SPIEKER.

Turritella infracarinata var. *zorritoensis* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 80, pl. 3, fig. 11. Upper Zorritos Formation, Miocene.

Turritella lissoni WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 79, pl. 8, figs. 4, 5. Negritos Formation, Eocene.

Turritella negritosensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 78, pl. 7, figs. 5-7; pl. 8, figs. 1-3. Negritos Formation, Eocene. [Locs. 345, 861, C.A.S. coll.]

Turritella nelsoni SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 74, pl. 3, figs. 5, 6. Upper Zorritos Formation, Miocene. [Locs. 328, 336, C.A.S. coll.]

Turitella suturalis NELSON (in part), Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 188, not figured. Zorritos, Peru.

Turritella infracarinata GRZYBOWSKI, WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 109, pl. 18, figs. 2, 3. Zorritos Formation, Miocene.

Turritella nelsoni var. *rotundata* GRZYBOWSKI, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 77, pl. 3, fig. 7. Upper Zorritos Formation, Miocene.

Turritella rotundata GRZYBOWSKI, Neues Jahrb. Min. Geol. Pal. Bl. Bd. 12, p. 643, pl. 20, fig. 6. Zorritos Formation, Miocene.

Turritella suturalis NELSON (in part), Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 188.

Turritella nelsoni var. *trullissatia* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 78, pl. 3, fig. 8. Upper Zorritos Formation, Miocene.

Turritella prenuncia SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, p. 81, pl. 4, figs. 1-3. Lower Zorritos Formation, Miocene. [Loc. 331, C.A.S. coll.]

Turritella prenuncia var. *inconspicua* GRZYBOWSKI, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 83, pl. 4, fig. 4. Zorritos Formation, Miocene.

Turritella inconspicua GRZYBOWSKI, Neues Jahrbuch Min. Geol. Pal. Bl. Bd. 12, 1899, p. 644, pl. 20, fig. 4, Zorritos Formation, Miocene.

Turritella (Haustator) robusta Grzybowski. See *Turritella supraconcava* Hanna & Israelsky, new name.

Turritella robusta var. *abrupta* Spieker. See *Turritella supraconcava* var. *abrupta* Spieker.

Turritella rotundata Grzybowski. See *Turritella nelsoni* var. *rotundata* Grzybowski.

Turritella supraconcava Hanna & Israelsky, new name. [Loc. 555, C.A.S. coll.]

Turritella (Haustator) robusta Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 646, pl. 20, fig. 3. Zorritos Formation, Miocene.—Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 84, pl. 4, fig. 5. Upper Zorritos Formation, Miocene. *Turritella*, sp. ind. Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 190, not fig'd. Zorritos.—Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 110, pl. 18, fig. 4, pl. 19, fig. 1. Zorritos Formation, Miocene. [Loc. 555, C.A.S. coll.].

Not *Turritella robusta* Gabb, Geol. Surv. Calif. Vol. 1, 1864, p. 135, pl. 21, fig. 94. Cretaceous, California.

Turritella supraconcava var. *abrupta* Spieker.

Turritella robusta var. *abrupta* Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 85, pl. 4, fig. 6. Zorritos Formation, Miocene.

Turritella suturalis Nelson. See *Turritella nelsoni* Spieker and *Turritella nelsoni* var. *rotundata* Grzybowski.

Turritella tricarinata Brocchi, Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 644. Ovibo Formation, Oligocene. (This name was applied to a European fossil by Brocchi.)

Turritella sp. ind. Nelson. See *Turritella supraconcava* Hanna & Israelsky, new name.

Tympanotonus lagunitensis Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 90, pl. 11, figs. 10-12. Lobitos Formation, Eocene.

Uvanilla, sp. ind., Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 187, not fig'd. Zorritos, Peru.

Vermetus, sp. ind., Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, 188, not fig'd. Zorritos.

Volutilithes plicifera Gabb, Amer. Journ. Conch., Vol. 5, 1869, p. 28, Tertiary, Payta, Peru.—Gabb, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264, pl. 35, fig. 6 *(Volutoderma)*.

Volutospina crassiuscula Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 104, pl. 15, figs. 6, 7; pl. 16, fig. 1. Negritos Formation, Eocene.

Volutospina meridionalis Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 105, pl. 16, fig. 2. Negritos and Lower Lobitos Formations, Eocene.

Volutospina peruviana Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 101, pl. 14, figs. 5-7; pl. 15, figs. 1-5. Negritos and Lobitos Formations, Eocene. [Loc. 850, C.A.S. coll.]

Pelecypoda

Amiantis incrassata var. *ovoidalis* Sacco, Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 146, pl. 9, fig. 5. Zorritos Formation?, Miocene.

Anomia berryi Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 127, pl. 7, figs. 6, 7. Upper Zorritos Formation, Miocene.

Anomia, sp. ind., Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 206, not fig'd. Zorritos, Peru.

Arca (Scapharca) charanensis Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 109, pl. 5, fig. 15. Lower Zorritos Formation, Miocene.

Arca (Noetia) cholana Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 95, pl. 5, figs. 2, 3. Variegated (near base) Formation, Miocene.

Arca (Scapharca) crescens Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 116, pl. 6, figs. 3, 4. Upper Zorritos Formation, Miocene.

Arca (Scapharca) fissicosta Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 102, pl. 5, fig. 11. Lower Zorritos Formation, Miocene.

Arca (Scapharca) hispaniolana Maury (?), Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, p. 110. Lower Zorritos Formation, Miocene.

Arca (Scapharca) imporcata Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 113, pl. 5, figs. 19, 20. Upper Zorritos Formation, Miocene.
Arca larkinii Nelson, Grzybowski, Neues Jahrbuch, Min. Geol. Pal., Bl. Bd. 12, 1899, p. 633.

Arca larkinii Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 204, pl. 7, figs. 5, 6, 7. Zorritos, Peru. [Locs. 329, 338, 341, 346, C.A.S. coll.]
Arca (Scapharca) larkinii Nelson, Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 111, pl. 5, figs. 16-18. Horizon not known.
Not *Arca larkinii* Nelson, Grzybowski. See *Arca imporcata* Spieker.

Arca (Noëtia) modesta Grzybowski. See *Arca retractata* Hanna & Israelsky, new name. Zorritos Formation.

Arca (Anadara) nelsoni SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 119, pl. 6, figs. 7, 8. Upper Zorritos Formation, Miocene.

Arca obesiformis GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 633, pl. 18, figs. 3, 3a. Zorritos Formation, Miocene.
Arca (Scapharca) obesiformis GRZYBOWSKI, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 115, pl. 6, figs. 1, 2. Upper Zorritos Formation, Miocene.

Arca (Scapharca) pantheonensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 99, pl. 5, figs. 8, 9. Variegated Formation, Miocene.

Arca raimondii GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 31, Tertiary, Payta, Peru.—GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1876, p. 264, pl. 35, figs. 10, 10a.

Arca retractata HANNA & ISRAELSKY, new name. [Loc. 328, C.A.S. coll.]
Arca (Noëtia) modesta GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 635, pl. 18, figs. 4, 4a. Zorritos Formation, Miocene.
Not *Arca modesta* WINCHELL, Proc. Acad. Nat. Sci. Phila., 1863, p. 15.

Arca reversa GRAY, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 634, pl. 17, figs. 1, 1a. Payta Formation, Pliocene.

Arca septifera GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 633, pl. 18, figs. 2, 2a. Zorritos Formation, Peru.
Arca (Anadara) septifera GRZYBOWSKI, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 117, pl. 6, figs. 5, 6. Upper Zorritos Formation, Miocene.

Arca (Scapharca) singewaldi SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, p. 103, pl. 5, figs. 12, 13. Lower Zorritos Formation, Miocene.

Arca (Scapharca) singewaldi var. *doma* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 106. Lower Zorritos Formation, Miocene.

Arca (Anadara) toroensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 121, pl. 6, figs. 9, 10; pl. 7, fig. 1. Upper Zorritos Formation, Miocene.

Arca (Anadara) toroensis var. *crassa* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 124, pl. 7, fig. 2. Upper Zorritos Formation, Miocene.

Arca (Anadara) toroënsis var. *prolata* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 125, pl. 7, fig. 3. Upper Zorritos Formation, Miocene.

Arca valdiviana PHILIPPI, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, p. 632, pl. 18, figs. 1, 1a. Zorritos Formation, Miocene.

Arca (Scapharca) vanholsti SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 106, pl. 5, fig. 14. Lower Zorritos (base) Formation, Miocene.

Arca (Scapharca) zapotalensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 101, pl. 5, fig. 10. Lower Zorritos Formation, Miocene.

Arca (Cunearca) zorritensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 96, pl. 5, figs. 4, 5. Zorritos Formation, Miocene.

Scapharca, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, 1870, p. 205, not fig'd. Zorritos, Peru.

Not *Scapharca zorritoensis* WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 112, pl. 18, fig. 5.

Arca (Cunearca) sp. ind. SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 98, pl. 5, figs. 6-7. Variegated Formation, Miocene.

Axinæa paytensis D'ORBIGNY, GABB. See *Glycymeris paytensis* (D'ORB.) GABB.

Barbatia sp. WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 62, pl. 1, fig. 4. Negritos, Eocene.

Callista (Macrocallista) dickersoni WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 71, pl. 4, fig. 6. Negritos, Eocene.

Cardium affinis NELSON. See *Cardium spiekeri* HANNA & ISRAELSKY, new name.

Cardium (Trachycardium) peruvianum SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 135, pl. 8, fig. 1. Zorritos Formation, Miocene.

Cardium, sp. ind., NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 203, not fig'd. Zorritos, Peru.

Cardium pertenue GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 30. Tertiary, Payta, Peru. (Subgenus *Lævicardium*).—GABB, Journ. Acad. Nat. Sci. Phila. Ser. 2, Vol. 8, 1878, p. 264, pl. 35, figs. 9, 9a.

Cardium procurvatum GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 638, pl. 17, figs. 2, 2a. Talara Formation, Miocene.

Cardium spiekeri HANNA & ISRAELSKY, new name.

Cardium (Trigoniocardia) affinis (NELSON), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 136, pl. 8, figs. 2, 3. Lower Zorritos Formation, Miocene.

Hemicardia affinis NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 204, not fig'd. Zorritos, Peru.

Not *Cardium affine* VON MÜNSTER, Neues Jahrbuch, Min., 1835, p. 438.

Cardium subaucanum GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 637, not fig'd. Heath Formation, Miocene.

Cardium tenuimargo GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 638, pl. 17, fig. 13. Heath Formation, Miocene.

Cardium (Trachycardium) zorritensis SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 134, pl. 7, fig. 12. Lower Zorritos Formation, Miocene.

Chione (Chione) angelana SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 152, pl. 9, figs. 10, 11. Upper Zorritos Formation, Miocene.
Chione sp. ind., B, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 203, not fig'd. Zorritos, Peru.

Chione (Lirophora) hendersonii DALL, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 154. Lower Zorritos Formation, Miocene. [Loc. 859, C.A.S. coll.]

Chione (Lirophora) latilirata (CONRAD), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 155. Lower Zorritos Formation, Miocene.

Chione (Chione) propinqua SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 152, pl. 9, fig. 12. Lower Zorritos Formation, Miocene.

Chione sechuntana HANNA & ISRAELSKY, this paper, p. 47, pl. 7, fig. 2. Zorritos.

Chione variabilis NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 202, not fig'd. Zorritos, Peru.—SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 150, pl. 9, figs. 8, 9. Upper Zorritos Formation, Miocene.

Chione, sp. ind. A, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 202, not fig'd. Zorritos, Peru.

Chione, sp. ind. B, NELSON. See *Chione (Chione) angelana* SPIEKER.

Clementia dariena (CONRAD), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 141, pl. 8, fig. 5. Lower and Upper Zorritos Formation, Miocene. [Loc. 338, C.A.S. coll.]
?*Harvella,* sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd. Zorritos, Peru.

Clementia sp., cf. *dariena* (CONRAD), WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 113, pl. 20, fig. 4. Zorritos Formation, Miocene.

Corbula (Cuneocorbula) acutirostra SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 176, pl. 10, figs. 18, 19. Upper Zorritos Formation, Miocene.

Corbula arnoldi Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 74, pl. 5, figs. 7, 8. Negritos, Eocene.

Corbula bradleyi Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 200, not fig'd. Zorritos, Peru.
Corbula (Albidis) bradleyi Nelson, Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, p. 171, pl. 10, figs. 13, 14. Zorritos Formation, Miocene.

Corbula (Cuneocorbula) bravoana Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 174, pl. 10, fig. 17. Lower Zorritos Formation, Miocene.

Corbula (Cuneocorbula) fabiformis Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 172, pl. 10, fig. 15. Lower Zorritos Formation, Miocene.

Corbula lanceolata Grzybowski. See *Corbula talarana* Hanna & Israelsky, new name.

Corbula parinasensis Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 75, pl. 6, figs. 2, 3. Negritos, Eocene.

Corbula peruviana Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 73, pl. 5, figs. 4, 5. Negritos, Eocene.

Corbula (Aloidis) prenuncia Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 172, pl. 10, fig. 12. Lower Zorritos Formation, Miocene.

Corbula (Cuneocorbula) propinqua Spieker, Paleontology of the Zorritos Formation, Johns Hopkins, Univ. Studies in Geology, No. 3, p. 174, pl. 10, fig. 16. Variegated Formation, Miocene.

Corbula talarana Hanna & Israelsky, new name.
Corbula lanceolata Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 641, pl. 17, fig. 4. Talara Formation, Miocene. Not *Corbula lanceolata* Geinitz, Charac. Schichten Saech.—boehm. Kreide geb. 1843 (1842), p. 12, pl. 2, fig. 3.=*Anatina*.

Corbula waringi Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 74, pl. 5, fig. 6. Negritos, Eocene.

Corbula woodsi Hanna & Israelsky, this paper, p. 47, pl. 7, fig. 4. Eocene.

Corbula, sp. ind. Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 200, not fig'd. Zorritos, Peru.

Crassatellites (Scambula) berryi Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 131, pl. 7, figs. 9, 10. Lower Zorritos Formation, Miocene.

Crassatellites charanensis Woods, in Bosworth, Geology of Northwestern Peru, 1922, p. 112, pl. 19, fig. 6; pl. 20, figs. 1-3. Zorritos Formation, Miocene.

Crassatellites gibbosa (SOWERBY), NELSON. See *Crassatellites (Scambula) nelsoni* (GRZYBOWSKI).

Crassatellites (Scambula) nelsoni (GRZYBOWSKI), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 128, pl. 7, fig. 8. Lower Zorritos Formation, Miocene. [Loc. 858, C.A.S. coll.]
Crassatella gibbosa SOWERBY, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 203, pl. 7, fig. 9. Zorritos, Peru.
Venus nelsoni GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 639, pl. 19, figs. 2, 2a. Heath Formation, Miocene.

Crassatellites pizarroi HANNA & ISRAELSKY, this paper, p. 46, pl. 7, fig. 1. Zorritos.

Cytherea affinis GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, p. 639, not figured. Heath Formation, Miocene. This species, being unfigured, can probably not be recognized without access to the original specimens; the name is therefore not replaced herein, although it is preoccupied by *Cytherea affinis* DUJARDIN, Mem. Soc. Geol. France, Vol. 2, ser. 2, 1837, p. 260.

Cytherea planivieta GUPPY, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 639, pl. 19, fig. 3. Heath Formation, Miocene.

Dactylina chiloensis MOLINA, GABB, Amer. Journ. Conch. Vol. 5, 1869, p. 29. Tertiary, Payta, Peru.

Dosinia (Dosinidea) delicatissima BROWN & PILSBRY, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 140, not fig'd. Lower Zorritos Formation, Miocene.

Dosinia grandis NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd. Zorritos Peru.

Dosinia (Dosinidea) grandis NELSON, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 138, pl. 8, fig. 4. Variegated Formation, Miocene.

Dosinia lenticula GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 639, pl. 17, fig. 11. Heath Formation, Miocene.

Glycymeris paytensis (D'ORBIGNY).
Axinæa paytensis D'ORBIGNY, GABB, Amer. Journ. Conch. Vol. 5, 1869, p. 31. Payta, Peru, Tertiary.
Pectunculus paytensis (D'ORBIGNY), GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 635. Payta Formation, Pliocene.

?*Harvella*, sp. ind. NELSON. See *Clementia dariena* (CONR.).

Hemicardia affinis NELSON. See *Cardium spiekeri* HANNA & ISRAELSKY, new name.

Labiosa (Ræta) gabbi PILSBRY & JOHNSON, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 168, pl. 10, fig. 10. Upper Zorritos Formation, 1922.

Labiosa (Ræta) ventricosa SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geol., No. 3, 1922, p. 169, pl. 10, fig. 11. Zorritos Formation, Miocene.

Leda acuminata NELSON. See *Leda peruviana* DALL.

Leda acutisinuata GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 632, pl. 17, figs. 12, 12a. Heath Formation, Miocene.

Leda ingens WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 61, pl. 1, figs. 1-3. Negritos, Eocene.

Leda peruviana DALL, SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 93, pl. 5, fig. 1. Zorritos Formation, Miocene.
Leda acuminata NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 205, pl. 7, fig. 8. Zorritos, Peru. [Name preoccupied.]

Lucina paytensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 70, pl. 4, fig. 5. Lobitos, Eocene. [Loc. 555, C.A.S. coll.]

Lucina prosoptera GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 636, pl. 17, fig. 16. Heath Formation, Miocene.

Lucina pulchella GRZYBOWSKI. See *Lucina talarana* HANNA & ISRAELSKY, new name.

Lucina talarana HANNA & ISRAELSKY, new name.
Lucina pulchella GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 637, pl. 17, fig. 15, Talara Formation, Miocene.
Not *Lucina pulchella* AGASSIZ, Icon. des. Coq. Tert. 1845, p. 64; new name for *L. divaricata* LAMARCK, (not LINNAEUS).

Lutraria hortensia GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 641, pl. 19, fig. 4. Heath Formation, Miocene.

Lutraria vetula PHILIPPI, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 641. Heath Formation, Miocene.

Macrocallista helenæ SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 145, pl. 9, figs. 3, 4. Variegated Formation, Miocene.

Macrocallista cavachana HANNA & ISRAELSKY, this paper, p. 47, pl. 7, fig. 3. Eocene.

Macrocallista dickersoni WOODS. See under *Callista.*

Mactra zorritensis NELSON. See *Mulinia zorritensis* (NELSON).

Mactra, sp. ind. NELSON. See *Mulinia zorritensis* (NELSON).

Meretrix bosworthi WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 72, pl. 5, fig. 1. Negritos, Eocene.

Meretrix negritosensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 72, pl. 5, fig. 2; pl. 6, fig. 1. Negritos, Eosene. [Loc. 328, C.A.S., coll.]

Mulinia zorritensis (NELSON), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 165, pl. 10, figs. 8, 9. Zorritos Formation, Miocene.
Mactra zorritensis NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd.
Mactra sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd.

Mytilus euglyphus WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 63, pl. 1, figs. 6, 7. Negritos, Eocene.

Mytilus ungulatus LINNÆUS, GABB, Amer. Journ. Conch. Vol. 5, 1869, p. 31. Tertiary, Payta, Peru. (A living species of the Chilian coast.)

Nucula araucana PHILIPPI, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 631. Talara Formation, Miocene.

Nucula minuscula GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 632, pl. 17, fig. 10. Talara Formation, Miocene.

Ostrea buski WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 65, pl. 2, figs. 3, 4. Negritos, Eocene. [Loc. 346, C.A.S. coll.]

Ostrea gallus VALENCIENNES, GABB, Amer. Journ. Conch. Vol. 5, 1869, p. 32. Tertiary, Payta, Peru.

Ostrea inca WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 64, pl. 1, fig. 9; pl. 2, figs. 1, 2. Negritos, Eocene.

Ostrea iridescens GRAY, GABB, Journ. Acad. Nat. Sci. Phila., Ser. 2, Vol. 8, 1878, p. 264. Tertiary, Payta, Peru.

Ostrea latiareata GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 630, pl. 17, fig. 6. Heath Formation, Miocene.

Ostrea lunaris GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, p. 630, pl. 17, fig. 5. Payta Formation, Pliocene.

Ostrea oculata GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 629, pl. 17, fig. 3. Payta Formation, Pliocene [Loc. 346, C.A.S.]

Ostrea sculpta GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 631, pl. 17, figs. 8, 8a. Heath Formation, Miocene.

Ostrea, sp. ind. A, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 205, not fig'd. Zorritos, Peru.

Ostrea, sp. ind. B, NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 206, not fig'd. Zorritos, Peru.

Ostrea, sp. WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 65, pl. 2, fig. 5. Negritos, Eocene.

Panopæa, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 200, not fig'd. Zorritos, Peru.

Pecten densicinctus GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 628, pl. 17, fig. 12. Payta Formation, Pliocene.

Pecten incus HANNA & ISRAELSKY, new name. [Locs. 329, 341, C.A.S. coll.]

Pecten intercostatus GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 629, pl. 17, fig. 9. Payta Formation, Pliocene. Not *Pecten intercostatus* GRIFFITH, Syn. Char. Carb. Limestone Foss, Ireland, 1844, p. 95, pl. 18, fig. 4.

Pecten intercostatus GRZYBOWSKI. See *Pecten incus* HANNA & ISRAELSKY, new name.

Pecten paytensis GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. Vol. 12, 1899, p. 628, pl. 17, fig. 7. Payta Formation, Pliocene.

Pecten purpuratus LAMARCK, GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 32. Tertiary, Payta, Peru.

Pecten woodringi SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 125, pl. 7, figs. 4, 5. Upper Zorritos Formation, Miocene.

Pecten, sp. ind., NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 205, not fig'd. Zorritos, Peru.

Pectunculus paytensis (D'ORBIGNY), GRZYBOWSKI. See *Glycymeris paytensis*.

Perna arbolensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 65, pl. 3, fig. 1. Negritos and Lobitos, Eocene.

Phacoides (Pseudomiltha?) insleyi SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 132, pl. 7, fig. 11. Lower Zorritos, Miocene.

Pholas, sp. ind. NELSON, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 200, not fig'd. Zorritos, Peru.

Pitaria (Lamelliconcha) cora var. *æquicincta* SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 149, pl. 9, figs. 6, 7. Upper Zorritos Formation, Miocene.

Pitaria (Lamelliconcha) planivieta (GUPPY), SPIEKER, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 147, pl. 10, fig. 6. Lower Zorritos, Variegated, Miocene.

Psammobia darwini PHILLIPI, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 640, Zorritos Formation, Miocene.

Ræta gibbosa GABB, Amer. Journ. Conch., Vol. 5, 1869, p. 30. Tertiary, Payta, Peru.—GABB, Journ. Acad. Nat. Sci. Phila. Ser. 2, Vol. 8, 1878, p. 264, pl. 35, figs. 8, 8a.—GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, p. 640, Payta Formation, Pliocene.

Scapharca (Argina) sullanensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 62, pl. 1, fig. 5. Lobitos, Eocene.

Scapharca zorritosensis Woods, in Bosworth, Geology of Northwestern Peru, p. 112, pl. 18, fig. 5. Zorritos, Miocene. [The spelling of the specific name differs from Spieker's *Arca zorritensis*. Loc. 346, C.A.S. coll.]

Scapharca sp. ind. Nelson. See *Arca zorritensis* Spieker.

Semele solida Gray, Gabb, Journ. Acad. Nat. Sci. Phila. Ser. 2, Vol. 8, 1878, p. 264. Tertiary, Payta, Peru.

Solecurtus (Pharella) planifolliculus Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 163, pl. 10, fig. 7. Lower Zorritos Formation, Miocene.

Solen microsulcatus Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, pl. 640, pl. 18, fig. 5. Ovibio Formation, Oligocene.

Strigilla prora Hanley, Gabb, Amer. Journ. Conch. Vol. 5, 1869, p. 30. Tertiary, Payta, Peru.

Tagelus gibbus (Spengler), Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 162. Zorritos(?) Formation, Miocene.
Solecurtus, sp. ind. Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 200, not fig'd. Zorritos, Peru.

Tellina (Eurytellina) æquicincta Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, pl. 158, pl. 10, fig. 3. Lower to Upper Zorritos, Miocene.

Tellina (Angulus) pressa Dall, Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 159, pl. 10, fig. 4. Zorritos Formation, Miocene.
Tellina, sp. ind. B, Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd. Zorritos, Peru.

Tellina (Angulus?) singewaldi Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922. p. 161, pl. 10, fig. 5. Lower Zorritos Formation, Miocene.

Tellina zapotalensis Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 156, pl. 10, figs. 1, 2. Lower Zorritos Formation, Miocene.

Tellina, sp. ind. A, Nelson, Trans. Conn. Acad. Arts and Sciences, Vol. 2, pt. 1, 1870, p. 201, not fig'd. Zorritos, Peru.

Tellina, sp. ind. B, Nelson. See *Tellina (Angulus) pressa* Dall.

Transenella herviderana Spieker, Paleontology of the Zorritos Formation, Johns Hopkins Univ. Studies in Geology, No. 3, 1922, p. 143, pl. 9, figs. 1, 2. Lower Zorritos Formation, Miocene.

Venericardia clavidens Grzybowski, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 636, pl. 19, figs. 1, 1a. Zorritos, Miocene. [Locs. 346, 555, C.A.S. coll.]

Venericardia planicosta LAMARCK, WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 66, pl. 3, figs. 2, 3; pl. 4, figs. 1-3. Negritos and Lobitos, Eocene.

Venus (Chione) columbensis SOWERBY, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 639. Payta Formation, Pliocene.

Venus munsteri D'ORBIGNY, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 638. Heath Formation, Miocene.

Venus nelsoni GRZYBOWSKI. See *Crassatellites (Scambula) nelsoni* (GRZYBOWSKI).

Venus saginata PHILIPPI, GRZYBOWSKI, Neues Jahrbuch, Min. Geol. Pal. Bl. Bd. 12, 1899, p. 638, Payta Formation, Pliocene.

CRUSTACEA

Callianassa parinasensis WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 114, pl. 17, fig. 4. Lobitos, Eocene.

Callianassa americana WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 115, pl. 17, figs. 5, 6. Negritos, possibly Lobitos, Eocene.

Thaumastoplax eocenica WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 117, pl. 17, fig. 11. Negritos, Eocene.

Xanthopsis errans WOODS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 115, pl. 17, figs. 7-10. Negritos, Eocene.

ECHINOIDEA

Echinocyamus intermedius HAWKINS, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 120, text fig. 25. Lobitos, Eocene.

COELENTERATA

Dendrophyllia peruviana VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 134, pl. 23, fig. 3. Negritos, Eocene.

Haimesistræa distans VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 132, pl. 22, fig. 5. Negritos, Eocene.

Haimesiastræa humilis VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 131, pl. 22, figs. 3, 4. Negritos. Eocene.

Haimesiastræa peruviana VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 130, pl. 22, fig. 2. Negritos, Eocene.

Oculina peruviana VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 127, pl. 21, figs. 2-5. Negritos, Eocene.

Paracythus peruvianus VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 126, pl. 21, fig. 1. Negritos, Eocene.

Peruviaster VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 128. (Type *P. peruviana* VAUGHAN.)

Peruviaster peruviana VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 129, pl. 21, figs. 6, 7. Negritos, Eocene.

Stephanocœnia peruviana VAUGHAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 133, pl. 23, figs. 1, 2. Negritos, Eocene.

FORAMINIFERA

Lepidocyclina antillea CUSHMAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 137, pl. 24, fig. 2. Lobitos, Eocene.

Lepidocyclina antillea (?), CUSHMAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 138.

Lepidocyclina (Nephrolepidina) peruviana CUSHMAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 138, pl. 24, fig. 1. Lobitos, Eocene.

Nummulites, sp. (?), CUSHMAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 139.

Orthophragmina peruviana, CUSHMAN, in BOSWORTH, Geology of Northwestern Peru, 1922, p. 138, pl. 24, fig. 3. Lobitos, Eocene.

PLATE 7

Fig. 1. *Crassatellites pizarroi* HANNA & ISRAELSKY, new species, type 1722, Mus. Calif. Acad. Sci., from Loc. 858 C.A.S., Zorritos, Peru.

Fig. 2. *Chione sechurantana* HANNA & ISRAELSKY, new species, type 1724, Mus. Calif. Acad. Sci., from locality 339 C.A.S., Zorritos, Peru.

Fig. 3. *Macrocallista cavachana* HANNA & ISRAELSKY, new species, type 1723, Mus. Calif. Acad. Sci., from locality 555 C.A.S., Eocene, Peru.

Fig. 4. *Corbula woodsi* HANNA & ISRAELSKY, new species, type 1725, Mus. Calif. Acad. Sci., from locality 555 C.A.S., Eocene, Peru.

Fig. 5. *Turritella conquistadorana* HANNA & ISRAELSKY, new species, type 1707, Mus. Calif. Acad. Sci., from locality 850 C.A.S., Eocene, Peru.

Fig. 6. *Turritella cochleiformis* GABB, plesiotype 1708, Mus. Calif. Acad. Sci., from locality 555 C.A.S., Eocene, Peru.

Fig. 7. *Same,* plesiotype 1709, Mus. Calif. Acad. Sci.

Fig. 8. *"Clavilithes" atahuallpai* HANNA & ISRAELSKY, paratype 1719, Mus. Calif. Acad. Sci., from locality 339 C.A.S., Zorritos, Peru.

Fig. 9. *Same,* type 1718, Mus. Calif. Acad. Sci.

Fig. 10. *Siphonalia phosoidea* HANNA & ISRAELSKY, new species, paratype 1717, Mus. Calif. Acad. Sci. from locality 336 C.A.S., Zorritos, Peru.

Fig. 11. *Clavilithes burtti* HANNA & ISRAELSKY, new species, type 1720, Mus. Calif. Acad. Sci., from locality 850 C.A.S., Eocene, Peru.

Fig. 12. *"Surcula" mayi* HANNA & ISRAELSKY, new species, type 1721, Mus. Calif. Acad. Sci., from locality 850 C.A.S., Eocene, Peru.

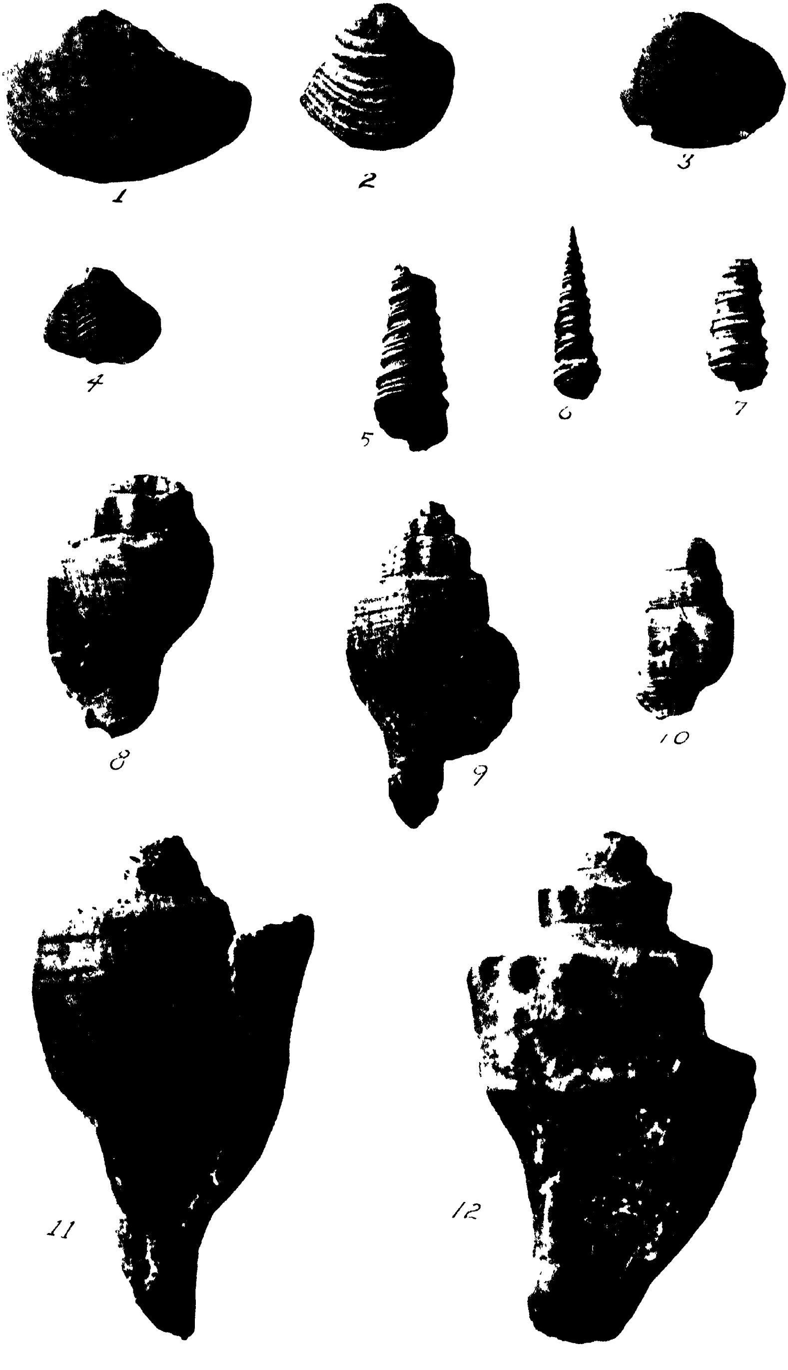
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PLATE 8

Fig. 1. *Melanatria* (?) *gesteri* HANNA & ISRAELSKY, new species, cotype 1712, Mus. Calif. Acad. Sci. from locality 334 C. A. S., Eocene, Peru.

Fig. 2. *Same*, cotype 1713, Mus. Calif. Acad. Sci.

Fig. 3. *Same*, cotype 1714, Mus. Calif. Acad. Sci.

Fig. 4. *Natica coronis* HANNA & ISRAELSKY, new species, type 1715, Mus. Calif. Acad. Sci. from locality 328 C. A. S., Zorritos, Peru.

Fig. 5. *Siphonalia phosoidea* HANNA & ISRAELSKY, new species, paratype 1717, Mus. Calif. Acad. Sci. from locality 336 C. A. S., Zorritos, Peru.

Fig. 6. *Turritella filicincta* GRZY., var. *varicosta* SPIEKER, plesiotype 1710, Mus. Calif. Acad. Sci. from locality 328 C. A. S., Zorritos, Peru. Figured to show aperture.

Fig. 7. *Siphonalia phosoidea* HANNA & ISRAELSKY, new species, type 1716, Mus. Calif. Acad. Sci. from locality 328 C. A. S., Zorritos, Peru.

Fig. 8. *Faunus paytense* (WOODS), plesiotype 1711, Mus. Calif. Acad. Sci. from locality 555 C. A. S., Eocene, Peru. Figured to show callosity of inner lip.


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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

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III

A NOTE ON TWO OF HYATT'S LIASSIC AMMONITES

BY

C. H. CRICKMAY

While working on the Jurassic faunas of western North America I have found that there is a vast assemblage of *nomina nuda*—chiefly names applied with no, or with incomplete, description by Alpheus Hyatt. To "rescue" all of these would be a stupendous, a well nigh impossible, task. However, as the types become located it will no doubt be possible to recognize and redescribe many of the species. On account of the interest attached to the Liassic ammonites because of their rarity a special search was made for the holotypes of two species described by Hyatt[1] and supposed to be in the collection of the California State Mining Bureau, San Francisco. These are *Arnioceras woodhulli* and *Vermiceras crossmani*.

1. **Vermiceras crossmani** Hyatt

Plate 9, figures 1-5

The type specimens of this species were eventually discovered in the museum of the California Academy of Sciences where the paleontological collections of the State Mining Bureau have been deposited. There are three fragments, one of

[1] **A. Hyatt: Jura and Trias at Taylorville, California. Bull., Geol. Soc. Am., Vol. 3, 1892, page 411.**

which is obviously another species. Of the remainder, the specimen showing the internal whorls is taken as the lectotype. The third specimen which is a small portion of the outer whorls of a large individual will be regarded as a paratype. Of the lectotype, the following description can be given: On the youngest visible whorls (diameter=12 mm.) the ornament is of versi-radiate costæ, about nine in a quadrant. The youngest whorls showing the venter (diam.=25 mm.) show a strong keel bordered by two deep and narrow sulci. The costæ soon become slightly arcuate.

At a diameter of 85 mm. geniculæ become evident and the costæ run up on to the venter and form a ridge bordering the sulci. At 104 mm., the major diameter of the specimen, tuberculation is almost attained. At this size there are 13 costæ in a quadrant. The suture line is not preserved. The following additional details are obtained from the paratype which is from a specimen of about 260 mm. diameter. At this size the costæ no longer run into the ridges bordering the ventral sulci, and there is a concave area just below the ridges. This individualizes the latter, giving the shell the appearance of having three equal keels. The costæ are about 20 in a quadrant.

MEASUREMENTS

Diameter	25 mm.	104 mm.	260 mm.
Width of umbilicus divided by diam.	.54	.62	
Thickness divided by diam..........	.33	.21	.14
Umbilical suture to keel div. by diam.	.26	.19	.19

The result is *Vermiceras crossmani* Hyatt, 1892; family Ammonitidæ (=Arietidæ).

Holotype: No. 1760; *paratype:* No. 1761, Calif. Acad. of Sci., from Santa Fé district, Esmeralda County, Nevada; early Sinemurian age (Lower Jurassic). S. H. Crossman, Coll. Original No. 4089, Calif. St. Min. Bureau.

2. **Arnioceras woodhulli** Hyatt

The type specimens of *Arnioceras woodhulli* could not be found. It is believed by the authorities of the institutions concerned that they have been lost. Under such circumstances it might still be possible to recognize the species from the brief

description and the comparison with *Arnioceras humboldti* which has been figured[2], were the locality known. But Hyatt did not give this any more accurately than Inyo County, California. Hyatt described the species very briefly as resembling *A. humboldti* but having the pilæ more closely crowded, and with slight constrictions at intervals on the adolescent whorls. These were said to disappear later, giving place to slightly arcuate costæ.

In view of the uncertainty connected with this species it might be thought best by some to declare the name invalid. This course would probably be quite justified but it seems a pity to take the step yet while so little is known of the Lias of the western states. It may be that *Arnioceras woodhulli* is the only Arnioceras in Inyo County, in which case its recognition would be relatively certain. It may be that there is no other species like it in the type area. Or perhaps some one of Hyatt's distinctions will prove distinctive when the entire fauna is known. For these reasons it is thought best not to decide this matter until considerable collections have been obtained from the Liassic rocks of the type region.

[2] A. Hyatt: Genesis of the Arietidæ, Smithsonian Contrib. to Knowl., No. 673, 1889, p. 173, figs. 31-33.

PLATE 9

Fig. 1. *Vermiceras crossmani* Hyatt. Holotype No. 1760 (Mus. Calif. Acad. Sci.) from Santa Fe District, Esmeralda County, Nevada. Lateral view, natural size.

Fig. 2. *Vermiceras crossmani* Hyatt. Holotype. Cross section of outer whorl.

Fig. 3. *Vermiceras crossmani* Hyatt. Paratype No. 1761 (Mus. Calif. Acad. Sci.) from Santa Fe District, Esmeralda County, Nevada. Lateral view, natural size.

Fig. 4. *Vermiceras crossmani* Hyatt. Paratype, same specimen as Fig. 3; ventral view, natural size.

Fig. 5. *Vermiceras crossmani* Hyatt. Paratype, same specimen as Fig. Fig. 3; apertural view, natural size.

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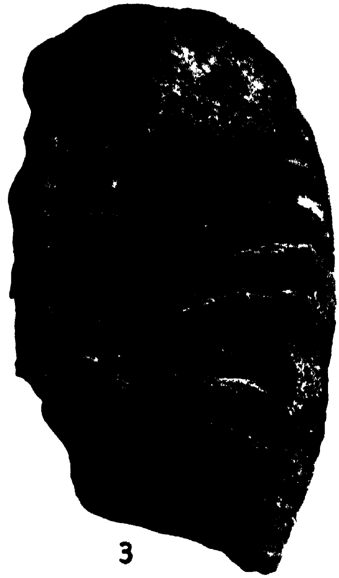

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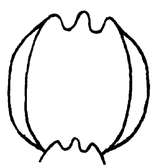

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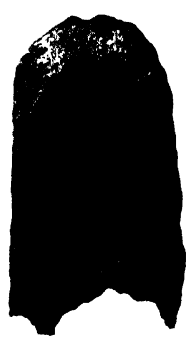

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IV

A NEW SPECIES OF MOLLUSK (*DENTALIUM HANNAI*) FROM LOWER CALIFORNIA, WITH NOTES ON OTHER FORMS

BY

FRED BAKER

In the course of a study of the members of the genus Dentalium taken in the Gulf of California in 1921 by the Expedition from the California Academy of Sciences certain specimens, found in my own collection and labeled *"Dentalium semipolitum"*, seem to belong to a new species. The shells were taken many years ago in a series of dredgings at varying depths by the late Miss J. M. Cooke and myself off the south end of South Coronado Island, Lower California. The location proved to be very rich in mollusks and we took more than a dozen species and a genus (Bernardina) which were later described as new by Doctors Dall and Bartsch, chiefly from our material. The dredging was all done in a single afternoon.

The species, on a superficial examination, is very like *D. semipolitum,* which is rather common in this region, and we overlooked the distinctive characters.

1. **Dentalium hannai** Baker, new species

Plate 10, figures 4, 5

Shell moderately curved, of medium size, very narrow at the apex but increasing rather rapidly at first, less decidedly later; length about 12 times the diameter, translucent, shining, blue-white at the anterior end and becoming slightly creamy on the posterior half; sculpture of the earlier third consisting of 28 fine, sharp, subequal ribs about a third as wide as interspaces, and all continuous, but gradually fading out at about a third of length of shell; growth striæ wavy and irregularly marked throughout; anal aperture, a slit on both convex and concave sides, but shorter and rounded on the latter, sharply pointed on the former; sides of apex grown inward, the slit occupying about a third of the diameter at this point; these inward projection of shell substance can hardly be called "a plug" in the sense that this word is commonly used in Scaphapoda; aperture circular, intersecting the axis at a right angle; peristome thin.

Length 38.5 mm.; diameter of base 3.2 mm.; diameter of apex 0.6 mm.; length of slit, convex side, 1.5 mm., concave side 0.6 mm.

Type: No. 1757, Mus. Calif. Acad. Sci., from 10 to 18 fathoms about **one mile south of South Coronado Island, Lower California**; Jeanette M. Cooke and Fred Baker, colls.

The arrangement of sculpture resembles that of *D. semipolitum* B. & S. and *D. inversum* Desh. from the same region, and *D. sectum* Desh. from the Gulf of California, in having longitudinal sculpture on the posterior third, the rest of the shell being smooth. The apical angle is slightly greater than in any of these species, but the most marked difference exists in the anal slit; this is wanting in *semipolitum;* on the concave side only in *inversum; sectum* differs radically in that is has a longer and oblique plug with the transverse slit not extending far on either the convex or concave side.

Other smaller specimens than the type are very constant in most of the characters though differing in the proportion of sculptured to smooth parts on account of age.

The species is named for Dr. G. Dallas Hanna, Curator of Paleontology, California Academy of Sciences.

2. **Dentalium vallicolens** Raymond

Plate 10, figures 1-3

This species was described in 1904[1] from specimens dredged in relatively deep water off La Jolla, California, and neighboring localities. It is much larger than *D. hannai* and in no specimens seen is there a notch or slit in the apical opening. The species has not been figured until now and this opportunity is taken to publish photographs of three specimens. Two of these (figs. 1, 2) are No. 437 of the Scripps Institution collection from 110 fathoms off La Jolla. These were undoubtedly used by Prof. Raymond in the description of the species; no type material was designated. The third specimen figured came from 120 fathoms off San Diego and has been presented to the California Academy of Sciences where it is No. 1758 (Coll. Type material).

[1] The Nautilus, Vol. 17, 1904, p. 123.

PLATE 10

Figs. 1, 2. *Dentalium vallicolens* Raymond. Plesiotypes, No. 437 (Scripps Institution), from 110 fathoms, off La Jolla, California. Enlarged slightly more than two diameters.

Fig. 3. *Dentalium vallicolens* Raymond. Plesiotype, No. 1758 (California Academy of Sciences), from 120 fathoms off San Diego. Enlarged slightly more than two diameters.

Fig. 4. *Dentalium hannai* Baker, new species. Type, No. 1757 (California Academy of Sciences), from 10-18 fathoms off South Coronado Island, Lower California. Enlarged slightly more than two diameters.

Fig. 5. *Dentalium hannai* Baker, new species. Type specimen; apex; enlarged six diameters.

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V

CONTRIBUTIONS TO ORIENTAL HERPETOLOGY
II. KOREA or CHOSEN

BY

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The herpetological fauna of Korea or Chosen is represented in the Academy's collection by 24 species. These are two salamanders, one discoglossid toad, one toad of the genus *Bufo,* one tree-frog, one engystomatid, five frogs, three lizards, eight snakes, and two turtles. Following is an annotated list of the species:

1. **Hynobius leechii** Boulenger

Our very large series has been reported upon by Dr. Dunn.

31841 to 32126. Fusan, Kjong-Sang-Do Province.
32127 to 32160. Chiksan, Kwi-Do Province.
32161 to 32167. Kong-Ju, Tschhung-Tschhong-Do Province
32168. Wonsan, Kang-Won-Do Province.
32374. Fusan, Kjong-Sang-Do Province.
35958 to 35975. Fusan, Kjong-Sang-Do Province.

2. **Onychodactylus fischeri** (Boulenger)

We have four adults (Nos. 32169 to 32172) and a very large series of larvæ (Nos. 32173 to 32373; 32984 to 32993; and 35977 to 35988) all collected at Wonsan, Kang-Won-Do Province. Most of these have been recorded by Dr. Dunn.

3. **Bombina orientalis** (Boulenger)

Males collected in May and June have the horny breeding pads on the fore limbs. In our series of more than 100 Korean specimens there is a great variation in the extent and uniting of the black ventral markings. Males usually are much more warty above than females and have much larger webs. They also show black dorsal markings much less distinctly than the females. However, there is a good deal of individual variation as regards all three of these sexual differences. Three young have very small webs. Our specimens are as follows:

17667 to 17669. Fusan, Kjong-Sang-Do Province, October, 1909.
32413 to 32457. Fusan, Kjong-Sang-Do Province, May 8, 1911.
32458 to 32478. Chiksan, Kwi-Do Province, June 16, 1911.
32479 to 32485. Sei-Shin, Ham-Gjong-Do Province, May 5, 1911.
32486 to 32504. Hoi-Ryong, Ham-Gjong-Do Province, May 22, 1911.
32505 to 32514. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32515 to 32518. Sagawansa, June 8, 1911.
32519. Musan Pass, May 22, 1911.
35936 to 35938. Chiksan, Kwi-Do Province, June 16, 1911.

4. **Bufo bufo asiaticus** (Steindachner)

Thirty toads from Korea agree very well with specimens from China. They differ from the toads of Japan in the absence of the dark line along the lower jaw and in the less extensive pigmentation of the belly and of the sides of the body.

32375 to 32399. Wonsan, Kang-Won-Do Province, Korea, June 7, 1911. The web is large in all. The tympanum is small or moderate, except in 32386, in which it is large. There is no black line on the lower jaw. Most of the specimens are without much ventral pigmentation; 32380, 32388, 32390, 32393, 32394 show a few small dark spots on the belly; and 32379 and 32385 have many small spots. The lateral pigmentation varies considerably in amount. 32385, 32396, 32398 each have a ridge of small tubercles in the position of a tarsal fold.

32400 to 32411. Kong-Ju, Tschhung-Tschhong-Do Province, Korea, June 10, 1911. The web is large. The tympanum is moderate or small. There is no dark line on the lower jaw. There is not much lateral pigmentation. 32401, 32404, 32409

have numerous small spots on the belly; 32410, 32411 have a few small spots; the others are unspotted. 32404 has a tarsal ridge of small tubercles.

32412. Wonsan, Kang-Won-Do Province, June 5, 1911.

35989. Wonsan, Kang-Won-Do Province, June 1, 1911. Large web. Small tympanum. No jaw line. No belly spots. Considerable lateral black.

36009 to 36011. Kong-Ju, Tschhung-Tschhong-Do Province, June 13, 1911. Large web. Tympanum moderate in 36009, 36010; large in 36011. No dark jaw line. Little lateral black. 36009 has numerous small belly spots, and a tarsal ridge of tubercles.

5. **Hyla aboria japonica** Günther

Our series from Japan and Korea show that it is not possible to distinguish a subspecies *H. a. immaculata.* Of 37 specimens collected at Kong-Ju, Korea, June 10, 1911, 33 have some web between the third and fourth fingers, while four (Nos. 32957, 32966, 32971, 32975) have no web between these fingers. All of the four have loreal dark streaks, and these streaks are clearly shown, also, by all of the 33 except No. 32958, which has none, and Nos. 32950 and 32965, each of which has a mere trace. Loreal streaks are present in all our other Korean Hylas except two from Wonsan. These are No. 32929, in which there is a trace of the stripe, and No. 32932, in which the stripe is entirely wanting. Both have finger webs.

32887 to 32926. Fusan, Kjong-San-Do Province, May 6, 1911.
32927 to 32940. Wonsan, Kang-Won-Do Province, June 7, 1911.
32941 to 32977. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32978 to 32983. Sei-Ko-Shin, Ham-Gjong-Do Province, May 13, 1911.
35935. Chiksan, Kwi-Do Province, June 16, 1911.
36012 to 36024. Kong-Ju, Tschhung-Tschhong-Do Province, June 13, 1911.

6. **Cacopoides borealis** Barbour

A large series of this little known species was secured at Chiksan, Korea, June 16, 1911 (Nos. 32520 to 32572 and Nos. 35939 to 35944). It may be supposed that the species was breeding at that time. Some of the specimens are nearly

black over all of the upper surfaces. Others are quite light in general coloration, with various cloudings, blotches, spots or dots of dark brown, slate or black. The light ground color in the less pigmented specimens may be gray or pale brown, sometimes with a trace of pink.

7. **Rana chinensis** Osbeck

Our Korean collections include about 109 specimens of this frog. They seem to show no difference in any way between Japanese and Chinese specimens. Frequently there is no dorsal line or band. Such specimens may resemble *Rana plancyi*, but may be readily distinguished by their dorsal dermal ridges which are lacking in *Rana plancyi*.

32766 to 32790. Sei-Shin, Ham-Gjong-Do Province, May 15, 1911.
32791 to 32824. Fusan, Kjong-Sang-Do Province, May 8, 1911.
32826 to 32839. Fusan, Kjong-Sang-Do Province, May 8, 1911.
32840. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32844 to 32845. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32849. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32853. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32854 to 32863. Hoi-Ryong, Ham-Gjong-Do Province, May 21, 1911.
32864 to 32870. Wonsan, Kang-Won-Do Province, June 7, 1911.
32873 to 32874. Sagawansa, June 8, 1911.
32875 to 32886. Sei-Ko-Shin, Ham-Gjong-Do Province, May 13, 1911.
35957. Fusan, Kjong-Sang-Do Province, May 8, 1911.

8. **Rana plancyi** Lataste

This frog seems not to be on record from Korea. Nevertheless it must be fairly common there, as we have 14 specimens from four localities, as follows:

32825. Fusan, Kjong-Sang-Do Province, May 8, 1911.
32841 to 32843. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32846 to 32848. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32850 to 32852. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32871 to 32872. Chiksan, Kwi-Do Province, June 16, 1911.
36002 to 36003. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.

9. **Rana temporaria** Linnæus

Our Korean collections include numerous frogs of the *temporaria* group. There is much variation, particularly in the position of the vomerine teeth, in specimens from the same locality. To the name *Rana temporaria* have been referred specimens which agree in having the dorsolateral ridge flaring out anteriorly toward the tympanum, the snout short, the web large or very large, and no definite light line along the upper jaw. The vomerine teeth may be between the choanæ (as in Nos. 32727, 32763), between and behind (as in Nos. 32748, 32750, 32751, 32762, 32765), or behind the choanæ (as in Nos. 32749, 32752, 32753, 32764). The outer metatarsal tubercle may be absent (No. 32749), but is present in nearly all.

32700 to 32726. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
32727. Hoi-Ryong, Ham-Gjong-Do Province, May 21, 1911.
32748 to 32753. Musan Pass, May 22, 1911.
32754 to 32761. Wonsan, Kang-Won-Do Province, June 7, 1911.
32762 to 32765. Sei-Shin, Ham-Gjong-Do Province, May 15, 1911.
35991 to 35997. Pu-Ryong, Ham-Gjong Do Province, May 22, 1911.

10. **Rana japonica** (Günther)

The frogs which have been referred to this species agree in the possession of dorsolateral ridges which either are very indistinct or wanting anteriorly, or run forward without bending out much toward the tympanum, long snouts, small webs, and usually a very distinct light line along the upper jaw. The vomarine teeth vary in position as they do in *Rana temporaria*, being sometimes between the choanæ (as in Nos. 32738, 32740, 32745, 32747), sometimes between and behind (as in Nos. 32728, 32731, 32733, 32735, 32736, 32737, 32739, 32741, 32742, 32743, 32746), and sometimes quite behind the choanæ (as in Nos. 32729, 32730, 32732, 32734, 32744). The outer metatarsal tubercle is usually absent (32729, 32730, 32731, 32733), but may be present on one side only (36006, 36008) or on both sides (32728, 32732, 36028). Nos. 36029 and 36030 have larger webs than the other specimens, and their snouts seem a little shorter. The dorsolateral ridge flares out somewhat in Nos. 35934, 36007 and 36008.

32728 to 32733. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32734 to 32747. Sei-Ko-Shin, Ham-Gjong-Do Province, May 13, 1911.
35934. Chiksan, Kwi-Do Province, June 16, 1911.
36004 to 36008. Kong-Ju, Tschhung-Tschhong-Do Prov., June 12-13, 1911.
36028 to 36030. Sei-Ko-Shin, Ham-Gjong-Do Province, May 13, 1911.

11. **Rana rugosa** Schlegel

This frog has apparently not been previously recorded from Korea. It must, however, be common there, for we have more than 130 specimens from six localities. Korean and Japanese specimens appear to be identical.

32573 to 32652. Fusan Kjong-Sang-Do Province, May 8, 1911.
32653 to 32667. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
32668 to 32671. Sagawansa, June 8, 1911.
32672 to 32678. Wonsan, Kang-Won-Do Province, June 7, 1911.
32679 to 32686. Sei-Shin, Ham-Gjong-Do Province, May 15, 1911.
32687 to 32698. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
32699. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
35955 to 35956. Fusan, Kjong-San-Do Province, May 8, 1911.
35998 to 36000. Kong-Ju, Tschhung-Tschhong-Do Province, June 12, 1911.

12. **Takydromus amurensis** Peters

This species is well represented in our collection by specimens from many localities in Korea. These are listed below:

31685 to 31733. Wonsan, Kang-Won-Do Province, June 7, 1911.
31777. Kong-Ju, Tschhung-Tschhong Province, June 10, 1911.
31812. Chiksan, Kwi-Do Province, June 16, 1911.
31818. Chiksan, Kwi-Do Province, June 16, 1911.
31819 to 31823. Musan Pass, May 22, 1911.
31824 to 31828. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
31829 to 31836. Sei-Shin, Ham-Gjong-Do Province, May 15, 1911.
31837 to 31839. Shoko, May 23, 1911.
31840. Hoi-Ryong, Ham-Gjong-Do Province, May 21, 1911.
33013. Wonsan, Kang-Won-Do Province, June 7, 1911.
33014. Shoko, May 23, 1911.
35976. Wonsan, Kang-Won-Do Province, June 6, 1911.

13. **Takydromus wolteri** Fischer

This grass lizard is represented from only three localities in Korea. All of the specimens have one pore on each side.

31546 to 31684. Fusan, Kjong-Sang-Do Province, May 8, 1911.
31734 to 31735. Wonsan, Kang-Won-Do Province, June 7, 1911.
31807 to 31811. Chiksan, Kwi-Do Province, June 16, 1911.
31813 to 31817. Chiksan, Kwi-Do Province, June 16, 1911.
33015. Fusan, Kjong-Sang-Do Province, May 8, 1911.
35945 to 35954. Fusan, Kjong-Sang-Do Province, May 8, 1911.

14. **Eremias argus** Peters

This lizard was secured in good series at two localities in Korea, as listed below. These specimens seem not to differ from those we have received from China.

31736 to 31776. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
31778 to 31806. Chiksan, Kwi-Do Province, June 16, 1911.
35933. Chiksan, Kwi-Do Province, June 22, 1911.
36025 to 36027. Kong-Ju, Tschhung-Tschhong-Do Province, June 14 ,1911.

15. **Natrix vibakari vibakari** Van Denburgh

This subspecies differs from that of the Japanese islands in having fewer urosteges. These vary from 55 to 65, average in nine specimens 61, while in *N. vibakari vibakari* the counts vary from 63 to 83, average in 34 specimens 71.4. There is but little difference in the counts of males and females.

Our Korean collections contain four of these snakes taken at Fusan, Kjong-Sang-Do Province, May 8, 1911. The counts of these specimens are given below. No. 31487 is the type. All have 19 scale rows.

No.	Sex	Gastrosteges	Urosteges	Supralabials	Infralabials	Preoculars	Postoculars	Loreal	Temporals
31485	♀	148	65c	7–7	8–8	1–1	2–3	1–1	1+1–1+1
31486	♀	142	61c	6–6	8–8	2–2	3–2	1–1	1+1–1+1
31487	♂	153	64c	7–7	8–8	1–1	3–2	1–1	1+1–1+1
31488	♀	146	56c	7–7	8–8	1–1	2–2	1–1	1+1–1+1

16. **Natrix tigrina tigrina** (Boie)

Our Korean collections include 27 snakes of this subspecies taken at the following localities:

31448 to 31454. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
31461 to 31469. Fusan, Kjong-Sang-Do Province, May 8, 1911.
31489 to 31496. Wonsan, Kang-Won-Do Province, June 7, 1911.
31530 to 31531. Chiksan, Kwi-Do Province, June 16, 1911.
31544. Ujo, May 23, 1911.

The counts of these specimens are given below. All have 19 scale rows. The anal is divided.

No	Sex	Gastro-steges	Uro-steges	Supra-labials	Infra-labials	Pre-oculars	Post-oculars	Temporals
31448	♀	171	52+	7−7	8−9	2−2	3−3	1+1−1+1
31449	♂	164	71c	7−7	8−7	2−2	3−3	1+2−1+2
31450	♂	163	71c	7−7	8−8	2−2	3−3	1+2−1+2
31451	♀	163	57+	7−7	8−8	2−2	3−3	1+2−1+2
31452	♀	172	43+	7−7	8−8	2−2	3−3	1+2−1+2
31453	♀	167	63c	7−7	8−8	2−2	3−3	1+2−1+2
31454	♂	159	67c	7−7	8−8	2−2	3−3	1+2−1+2
31461	♀	168	59c	7−7	8−9	2−2	3−3	1+2−1+2
31462	♀	163	61c	7−7	8−8	2−2	3−3	1+2−1+2
31463	♂	159	71c	7−7	8−8	2−2	4−4	1+2−1+2
31464	♂	164	74c	7−7	8−8	2−2	3−3	1+2−1+2
31465	♀	166	50+	7−7	8−8	2−2	3−3	1+2−1+2
31466	♂	165	67c	7−7	8−8	2−2	3−3	1+2−1+2
31467	♀	169	65c	7−7	8−8	2−2	3−3	1+2−1+2
31468	♀	165	61c	7−7	8−8	2−2	3−3	1+2−1+2
31469	♀	168	64c	7−7	9−8	2−2	3−3	1+2−1+2
31489	♂	163	70c	7−7	8−9	2−2	3−3	2−2
31490	♂	157	71c	7−7	9−9	2−2	3−3	1+2−1+1
31491	♂	155	70c	7−7	9−8	2−2	2−2	1+1−1+2
31492	♂	153	70c	7−7	9−8	2−2	3−3	1+2−1+2
31493	♂	158	69c	7−7	9−9	2−2	3−3	1+2−1+2
31494	♂	155	68c	7−7	9−9	2−2	3−3	1+2−1+2
31495	♂	158	69c	7−7	8−8	2−2	3−3	1+2−1+2
31496	♀	163	72c	7−7	9−9	2−2	3−3	1+2−1+2
31530	♂	158	69c	7−7	8−8	2−2	3−3	1+2−1+2
31531	♂	159	62c	7−7	8−9	2−2	3−3	1+2−1+2
31544	♀	161	41+	7−7	8−8	2−2	4−3	1+2−1+2

17. **Elaphe rufodorsata** (Cantor)

Twenty-nine Korean specimens of this snake are at hand, as follows:

17666. Fusan Kjong-Sang-Do Province, October, 1909.
31457 to 31459. Fusan, Kjong-Sang-Do Province, June 10, 1911.
31470 to 31476. Fusan, Kjong-Sang-Do Province, May 8, 1911.
31477 to 31482. Fusan, Kjong-Sang-Do Province, May 10, 1911.
31498 to 31499. Wonsan, Kang-Won-Do Province, June 7, 1911.

31502 to 31505. Wonsan, Kang-Won-Do Province, June 7, 1911.
31532 to 31533. Chiksan, Kwi-Do Province, June 16, 1911.
31535 to 31536. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
31545. Fusan, Kjong-Sang-Do Province, May 8, 1911.
33012. Fusan, Kjong-Sang-Do Province, May 8, 1911.

The counts of these specimens are given below. All have 21 scale rows.

No.	Sex	Gastrosteges	Urosteges	Anal	Supralabials	Infralabials	Preoculars	Postoculars	Temporals
17666	♀	176	50c	2	8–7	10–10	1–1	2–2	2+3–2+3
31457	♀	179	51c	2	7–8	10–10	1–1	2–2	2+3–2+3
31458	♂	168	59c	2	7–7	10–10	1–1	2–2	2+3–2+3
31459	♀	179	53c	2	7–7	10–10	1–1	2–2	2+3–2+3
31470	♂	169	61c	2	7–7	10–10	1–1	2–2	1+2–1+2
31471	♀	173	50c	2	7–7	10–10	1–1	2–2	2+2–2+3
31472	♀	179	37+	2	8–7	10–9	1–1	2–2	2+3–2+3
31473	♂	163	61c	2	7–7	10–10	1–1	2–2	2+3–2+2
31474	♀	178	51c	2	7–7	10–10	1–1	2–2	2+3–2+2
31475	♀	177	50c	2	8–8	10–10	1–1	2–2	2+2–2+2
31476	♀	174	51c	2	8–7	10–10	1–1	2–2	2+3–2+3
31477	♂	170	61c	2	8–8	10–10	1–1	2–2	2+3–2+3
31478	♀	183	51c	2	7–8	10–10	1–1	2–2	2+3–2+2
31479	♀	173	51c	2	8–7	10–9	1–1	2–2	2+3–2+3
31480	♀	177	52c	2	7–7	10–9	1–1	2–2	2+2–2+2
31481	♂	169	60c	2	7–7	10–10	1–1	2–2	2+2–2+3
31482	♂	168	57c	2	7–7	10–10	1–1	2–2	2+2–2+3
31498	♂	161	63c	2	7–7	10–10	1–1	2–2	2+2–2+2
31499	♀	177	49c	2	7–7	10–10	1–1	2–2	2+3–2+3
31502	♀	174	55c	2	7–8	10–10	1–1	2–2	2+3–2+3
31503	♂	168	62c	2	8–7	10–10	1–1	2–2	2+2–2+3
31504	♂	167	61c	2	7–7	10–10	1–1	2–2	2+3–2+3
31505	♂	168	62c	2	8–8	10–10	1–1	2–2	2+3–2+2
31532	♂	171	63c	2	7–7	10–10	1–1	2–2	1+3–2+3
31533	♂	167	62c	2	7–7	10–10	1–1	2–2	2+3–2+3
31535	♂	161	63c	2	7–7	10–9	1–1	2–2	2+3–2+3
31536	♂	163	59c	2	7–7	10–10	1–1	2–2	2+3–2+2
31545	♀	175	56c	2	8–8	10–10	1–1	2–2	2+2–2+2
33012	?	...	....	..	7–7	10–10	1–1	2–2	2 –2

18. **Elaphe schrenckii** Strauch

Nine specimens were collected in Korea, as follows:

31460. Fusan, Kjong-Sang-Do Province, May 8, 1911.
31497. Wonsân, Kang-Won-Do Province, June 7, 1911.
31513 to 31519. Chiksan, Kwi-Do Province, June 16, 1911.

The scale counts are as follows:

No.	Sex	Scale rows	Gastro-steges	Uro-steges	Anal	Supra-labials	Infra-labials	Pre-oculars	Post-oculars	Temporals
31460	♀	23	222	69c	2	8−8	10−10	1−1	2−2	2+3−2+3
31497	♀	23	223	67c	2	8−8	9−9	1−1	2−2	2+3−2+3
31513	♂	23	216	72c	2	8−8	10−10	2−2	1−1	2+3−2+3
31514	♂	23	217	64+	2	8−7	11−9	1−1	2−2	2+3−2+3
31515	♂	23	221	74c	2	8−8	9−10	2−2	2−2	2+3−2+3
31516	♂	23	227	67c	2	8−8	11−11	1−1	2−2	2+3−2+3
31517	♂	23	216	72+	2	7−8	10−9	1−1	1−1	2+3−2+3
31518	♀	23	129	71c	2	8−8	10−10	1−1	2−2	2+3−2+3
31519	♀	23	128	66c	2	8−8	10−10	1−1	2−2	2+3−2+3

19. **Elaphe dione** (Pallas)

Eight specimens of this snake have been received from Korea as follows:

31455 to 31456. Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.
31500. Wonsan, Kang-Won-Do Province, June 7, 1911.
31520 to 31522. Chiksan, Kwi-Do Province, June 16, 1911.
31534. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
31541. Sei-Shin, Ham-Gjong-Do Province, May 15, 1911.

The scale counts are given below.

No.	Sex	Scale rows	Gastro-steges	Uro-steges	Anal	Supra-labials	Infra-labials	Pre-oculars	Post-oculars	Temporals
31455	♂	25	203	64c	2	8−8	10−11	2−2	2−2	2+3−2+2
31456	♀	25	205	71c	2	8−8	11−11	2−3	2−2	2+4−2+4
31500	♀	27	199	62c	2	8−8	11−11	2−2	2−2	2+3−2+3
31520	♂	25	199	73c	2	8−8	11−11	2−2	2−2	2+3−2+3
31521	♀	25	200	59c	2	8−8	11−	2−2	2−2	2+4−2+3
31522	♂	25	193	71c	2	8−8	10−11	2−2	2−2	2+4−2+3
32534	♀	25	193	60c	2	8−8	11−11	1−1	2−2	2+4−2+4
31541	♀	23	197	56+	2	8−8	10−10	2−2	2−2	2+3−2+3

20. **Coluber spinalis** (Peters)

Our only Korean specimen of this snake (No. 31529) was taken at Chiksan, Kwi-Do Province, June 16, 1911. It is a female with scales in 17 rows, gastrosteges 203, urosteges 86

complete, anal divided, supralabials 8-8, infralabials 9-10, preoculars 2-2, postoculars 2-2, loreal 1-1, and temporals 2+2—2+2.

21. **Dinodon rufozonatum** (Cantor)

This species seems to be rather rare in Korea. Its occurence there has been known from one or two specimens without exact data. We have received only one, caught at Fusan, Kjong-Sang-Do Province, May 8, 1911. It is No. 31483, a male, with 17 scale rows, gastrosteges 201, urosteges 73 complete, anal single, supralabials 7-7, infralabials 9-9, preoculars 2-2, postoculars 2-2, no loreal, and temporals 2+3—2+3.

22. **Agkistrodon blomhoffii brevicaudus** Stejneger

Fourteen specimens of this subspecies are at hand from the following localities:

31506. Wonsan, Kang-Won-Do Province, June 7, 1911.
31508. Wonsan, Kang-Won-Do Province, June 7, 1911.
31510. Wonsan, Kang-Won-Do Province, June 7, 1911.
31512. Wonsan, Kang-Won-Do Province, June 7, 1911.
31523 to 31527. Chiksan, Kwi-Do Province, June 16, 1911.
31537 to 31539. Pu-Ryong, Ham-Gjong-Do Province, May 22, 1911.
31542. Shoko, May 23, 1911.
31543. Musan Pass, May 22, 1911.

The scale counts are as follows:

No.	Sex	Scale rows	Gastrosteges	Urosteges	Anal	Supralabials	Infralabials	Preoculars	Postoculars	Temporals
31506	♀	21	145	42c	1	7–7	10–10	2–2	2–2	2+3–2+3
31508	♀	21	143	33c	1	7–7	10–10	2–2	2–2	2+3–2+3
31510	♀	21	147	38c	1	7–7	10–10	2–2	2–2	2+3–2+4
31512	♂	21	146	49c	1	7–7	10–10	2–2	3–2	2+2–2+2
31523	♀	21	146	38c	1	7–7	10–10	2–2	2–2	2+3–2+3
31524	♂	21	149	54c	1	7–7	11–10	2–2	2–2	2+4–2+4
31525	♂	21	147	48c	1	7–7	10–10	2–2	2–2	2+3–2+3
31526	♀	21	150	43c	1	7–7	10–10	2–2	3–3	2+2–2+2
31527	♀	21	145	45c	1	8–7	11–11	2–2	2–2	2+3–2+3
31537	♂	21	147	27+	1	7–7	11–11	2–2	2–2	2+3–2+3
31538	♂	21	145	47c	1	7–7	10–10	2–2	2–2	2+3–2+3
31539	♀	21	155	43c	1	7–7	10–10	2–2	2–2	2+3–2+3
31542	♀	21	156	41c	1	7–7	11–10	2–2	3–3	2+3–2+3
31543	♂	21	153	42c	1	7–7	11–10	2–2	3–3	2+3–2+3

23. **Geoclemys reevesii** (Gray)

One typical specimen of this turtle (No. 31437) was collected at Kong-Ju, Tschhung-Tschhong-Do Province, June 10, 1911.

24. **Amyda maackii** (Brandt)

Sixteen soft-shelled turtles were collected at Kong-Ju, Tschhung-Tschhong-Do Province, June 10-14, 1911. These are Nos. 31438 to 31447 and 36055 to 36060. These turtles agree in having the interocular and especially the temporal dark stripes broader and more conspicuous than in Chinese specimens. They also have much more of the fine yellow dotting on all of the dorsal surfaces. They seem to differ from Chinese turtles only in color.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XIV, No. 6, pp. 101-103 JULY 23, 1925

VI

CONTRIBUTIONS TO ORIENTAL HERPETOLOGY

III. RUSSIAN ASIA and MANCHURIA

BY

JOSEPH. R. SLEVIN

Assistant Curator, Department of Herpetology

The fauna from these regions represented in the Academy's collection, although small, has nevertheless proved of value for comparison with material from adjacent territory. It is represented by one salamander, one frog, four snakes, and one turtle.

RUSSIAN ASIA

1. **Hynobius keyserlingii** (Dybowskii)

Our only specimen (No. 14578) was collected at Xanka Lake, Ussuri Province.

2. **Rana temporaria** Linnæus

Three frogs from Russian Asia seem to fall within the limits of individual variation in this species.

No. 14575, collected at Xanka Lake, Ussuri Province, May 7, 1908, has large webs, vomerine teeth between and somewhat

behind the choanæ, and large inner metatarsal tubercles. The outer metatarsal is present.

Two specimens are labeled "Ussuri?" No. 14576 has small webs, vomerine teeth between and behind the choanæ, and inner metatarsal tubercles small. No. 14577 has large webs, teeth well behind the choanæ, and inner metatarsal tubercles small. This last specimen has a dorsal stripe. Neither has outer metatarsal tubercles.

The dorsolateral ridge flares out anteriorly toward the tympanum in these three frogs.

3. **Natrix tigrina lateralis** (Berthold)

One female snake of this species (No. 14580) was collected at Vladivostoc. It has scales in 19 rows, gastrosteges 159, urosteges 55c, anal divided, supralabials 7-7, infralabials 8-8, preoculars 2-2, postoculars 3-3, loreal 1-1, and temporals 1+2—1+2.

4. **Elaphe schrenckii** Strauch

A female (No. 14583), taken at Vladivostoc, in 1903, has 23 scale rows, gastrosteges 218, urosteges 66c, anal divided, supralabials 8-8, infralabials 10-10, preoculars 2-2, postoculars 2-2, loreal 1-1, and temporals 2+3—2+3.

5. **Agkistrodon blomhoffii intermedius** (Strauch)

Stejneger is followed in the use of this name for two specimens from Vladivostoc, although their scale counts are similar to those of Korean specimens. They are Nos. 14585 and 14586. Their counts are as follows:

No.	Sex	Scale rows	Gastro-steges	Uro-steges	Anal	Supra-labials	Infra-labials	Pre-oculars	Post-oculars	Temporals
14585	♀	21	150	43c	1	7−7	10−9	2−2	2−2	1+3−1+3
14586	♂	21	147	46c	1	7−7	10−10	2−2	2−2	1+2−1+2

MANCHURIA

1. **Natrix tigrina lateralis** (Berthold)

The counts of two specimens labeled "North East Manchuria" are as follows:

No.	Sex	Scale rows	Gastrosteges	Urosteges	Anal	Supralabials	Infralabials	Preoculars	Postoculars	Temporals
33016	♀	19	162	58c	2	7–7	8–9	2–2	4–4	1+2–1+2
33017	♂	19	160	57c	2	7–7	9–9	2–2	3–3	1+2–1+2

2. **Amyda maackii** (Brandt)

One large specimen (No. 14587) collected at Harbin, Manchuria, in 1907, agrees in coloration with our series from Korea. Our Chinese specimens seem to represent a different species.

PROCEEDINGS

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VII

NEW NORTH AMERICAN SPIDERS

BY

RALPH V. CHAMBERLIN

Harvard University

The new spiders described in this paper were noted in connection with a study of the spiders collected by the Expedition of the California Academy of Sciences to the Gulf of California in 1921 upon which a report has previously been published.[1]

I am indebted to Prof. C. R. Crosby for the preparation of descriptions of several species of Linyphiidæ, the name of each such species being accordingly followed by his name in the text.

LIST OF THE SPECIES

AVICULARIIDÆ

1. **Brachybothrium shoshoneum** Chamberlin, new species

Male: Cephalothorax, sternum and legs fulvous or yellowish. Abdomen similar above but grey behind and laterally; the venter greyish yellow.

Pars cephalica low, rather flat and widely slanting to fovea thoracica. Fovea short and deep, the radiating lines rather coarse. Anterior median eyes with centers on or near the median transverse line of the ocular

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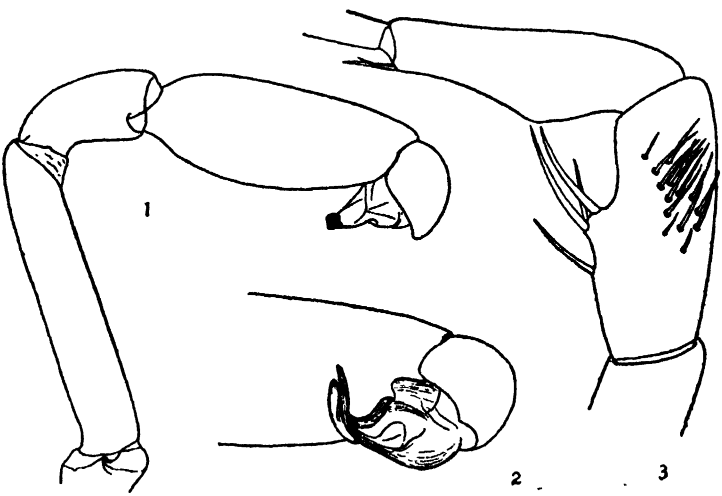
[1] Proceedings of the California Academy of Sciences, Vol. XII, No. 28, 1924.

area; close to the posterior median eyes, than which they are smaller. Cheliceræ rather small, the cephalothorax being nearly 3.2 times their antero-posterior length. On convex antero-dorsal surface at mesal side conspicuously elevated and bearing a dense patch of stout, basally spiniform setæ. Tarsi slightly flexuose. Paired claws with five or six teeth,



Brachybothrium shoshoncum
Fig. 1. Right palpus of male, ectal view. 2. Apical part of the same, more enlarged. 3. Tarsus and metatarsus of leg I of male, anterior view.

the unpaired claw smooth. Tibia I with a patch of long, stout spines on anterior surface just distad of middle; somewhat produced at middle beneath, and bearing there several longer and much stouter spines. Metatarsus I broadly produced beneath proximad of the middle (fig. 3). Palpus as shown in figs. 1 and 2.

Length, 11.2 mm.; Cephalothorax, 5.6 mm.; Tib. + pat. I, 5 mm.; Tib. + pat. IV, 5 mm.

Holotype: M. C. Z.,[2] No. 1149, (♂).

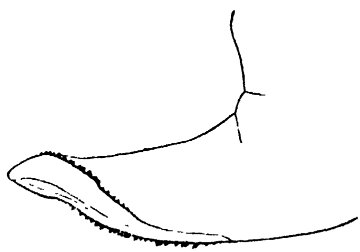
Type locality: Troy, Idaho.

2. **Eurypelma duplex** Chamberlin, new species

Male: Body and legs clothed with rusty brown hair of the usual type. Carapace as wide as long. Thoracic fovea nearly three-fourths the distance from anterior end to base. Anterior row of eyes viewed from in

[2] Museum of Comparative Zoology, Cambridge, Massachusetts.

front strongly procurved; medians about their diameter apart, less than half as far from the equal laterals. Posterior median eyes much smaller than the laterals, elongate; much closer to posterior laterals than to anterior medians. Claws of legs dentate proximad of middle. Tibia of leg I with the usual bilobate process at distal end, the outer branch more curved and about a third longer than the inner branch. Inner (anterior) surface of coxa I with many setæ, spine-like at base. Some similar spinescent



Eurypelma duplex
Fig. 4. Inner side of apex of bulb of male palpus.

setæ on caudal face of coxa of palpus. Tibia of palpus bearing four spines on inner side, two submedian and two toward distal end. Spines with double line of serrations as shown in fig. 4.

Length, 28 mm.; cephalothorax, 12 mm.; width, 12 mm. Tib. + pat. I, 18 mm.; met. I, 12 mm.; Tib. + pat. IV, 18.2 mm.; met. IV, 17 mm.

Holotype: M. C. Z., ♂.

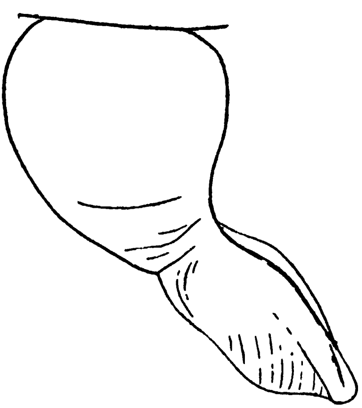
Type locality: Orizaba, Mexico.

Closely allied to *E. longipes* Cambridge and *E. serrata* Simon. It differs from the former in having a strongly developed carina on the inner surface of apex of bulb. It differs from *serrata* in having this carina, as well as the lower edge, strongly serrate, with a smooth, weaker carina between these two, and in having fewer spines on inner surface of the tibia of the palpus. It is smaller than either of the two species mentioned.

3. **Eurypelma epicureana** Chamberlin, new species

Male: Cephalothorax, legs and abdomen below clothed with brown hair. The dorsum of the abdomen clothed with shorter, dense, black hairs and longer bright rusty red hairs which are sparser caudally, where they leave a blackish spot more or less exposed.

Carapace longer than wide. Fovea .65 of the distance from anterior end to posterior end. Anterior row of eyes strongly procurved, a line tangent to lower margin of median eyes being nearly tangent to upper margin of lateral eyes. Anterior median eyes about their diameter apart; obviously smaller than the laterals. Posterior row of eyes equal in length to the anterior row. Posterior median eyes somewhat obvate, nearly touching the larger lateral eyes behind, farther removed, though by less than their radius, from the anterior medians. Claws of legs with a few weak teeth proximad of middle. Tibia I with the usual bifurcate



Eurypelma epicureana
Fig. 5. Anterior view of bulb of male palpus.

spur, the longer outer branch of which is bent mesad at tip. Metatarsus I curved toward base as in *lanceolatum*. On anterior face of coxa I, both above and below suture, the setæ are in part spinescent at base. Inner surface of tibia of palpus with six spines. Apical portion of bulb as shown in fig. 5.

Length, 40 mm.; cephalothorax, 20 mm.; width, 17.2 mm.; Tib. + pat. I, 21 mm.; met. I, 12.2 mm.; Tib. + pat. IV. 21 mm.; met. IV, 18 mm.

Holotype: M. C. Z., No. 1140, ♂; *Paratype,* M. C. Z., No. 1141, ♂.

Type locality: Chichen Itza, Yucatan.

Related to *E. lanceolatum* Simon. It differs from that species, aside from coloration and different proportions, also decidedly in the form of the stylus of bulb, which approaches more nearly to that of *vagans* Ausserer.

4. **Eurypelma stoica** Chamberlin, new species

Male: Body clothed with rusty brown hair.

Cephalothorax longer than wide, with the foveola about seven twelfths the distance from anterior end to caudal. Anterior median eyes clearly less than their diameter apart and not quite so far from the laterals. Anterior row in front view strongly procurved. Posterior median eyes elliptic, much smaller than the laterals, with which they are subcontiguous; distinctly recurved from anterior median eyes. Tarsal claws typically with three weak teeth near middle. Anterior face of coxa I with no hairs of basally stout or spinescent form. Tibia I with the double spine at distal

Eurypelma stoica
Fig. 6. Anterior view of bulb of male palpus.

end of usual general form, the outer branch longest, both branches curved somewhat toward each other, each terminating in a stout spine. Metatarsus I straight throughout. Inner side of tibia of palpus bearing six or seven spines. Bulb short, the apical portion spatuliform with lower margin finely serrate. See fig. 6.

Length, 23 mm.; cephalothorax, 11.5 mm.; width, 9.5 mm. Tib. + pat. IV, 14.7 mm.; met. IV, 13.8 mm. Tib + pat. I, 14.8 mm.; met. I, 8.2 mm.

Holotype: M. C. Z., No. 1142, ♂.

Type locality: Chichen Itza, Yucatan.

LINYPHIIDÆ

5. **Ceraticelus creolus** Chamberlin, new species

Male: Carapace and scuta of abdomen yellowish brown, the legs and soft parts of abdomen clearer yellow.

In the form of the cephalothorax suggesting *C. emertoni* (Cambridge), to which it is obviously related. The head protruding forward over the

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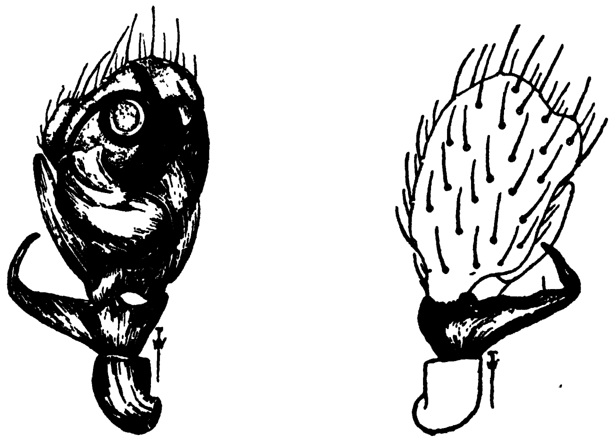
clypeus, rounded, not at all subdivided. The upper scutum of abdomen covers most of the dorsum; ventrally there is the usual epigastric plate and in addition one in front of spinnerets. The palpus has the tibial apophysis distally very slender, and bent nearly at right angles to the basal part but not uncate as it is in *C nubiliceps* Chamberlin, which is also a Louisiana species. It appears to differ clearly from other species of the same group in details of the bulb which are shown in figs. 9 and 10.

Length, 1.4 mm.

Female: Heavier than the male, with the cephalothorax normal. The abdomen retains the epigastric plate and the plate in front of spinnerets less developed but with no trace of the dorsal plate.

Length, 1.9 mm.



Ceraticelus creolus

Fig. 9. Right palpus of male, ventral view. 10. The same, dorsal view.

Holotype: M. C. Z., No. 1106, ♂ ; *Allotype,* M. C. Z., 1107, ♀ ; *Paratypes,* M. C. Z.

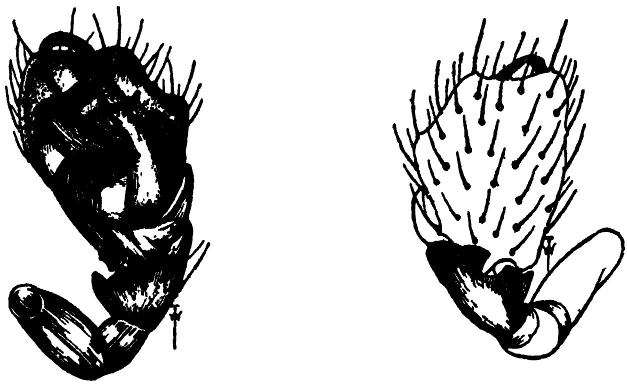
Type locality: Benton, Louisiana; R. V. Chamberlin coll.

6. **Ceratinopsis atolmus** Chamberlin, new species

Male: This is a small form in which the cephalothorax is brown, with the eye region black. The legs yellow. Abdomen dusky.

Head narrow, with the lateral eyes prominent but not on distinct tubercles. The species is characterized chiefly by the structure of the palpus. In this it suggests *C. anglicanus* but is readily distinguishable in details both of the tibial apophysis and of the bulb of the palpus as shown in figs. 11 and 12.

Length, 1.8 mm.



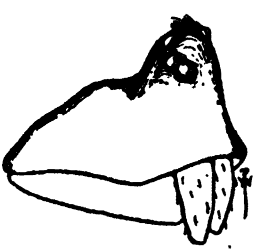
Ceratinopsis atolmus
Fig. 11. Left palpus of male, ventral view. 12. The same, sub-dorsal view.

Holotype: M. C. Z., 1105.

Type locality: Springfield, Tennessee.

Genus **Spirembolus** Chamberlin

In the genus Spirembolus Chamberlin the embolic division of the palpal organ is developed into a remarkable spiral as shown in figure 20. There is little variation in the palpal organ in the different species and it is, therefore, not figured for all.



Spirembolus perjucundus
Fig. 15. Cephalothorax, lateral view.

Spirembolus vallicolens
Fig. 16. Cephalothorax, lateral view.

Key to Species of Spirembolus, Males

a_1. Femur of palpus armed at tip on the inner angle with a small but distinct whitish process.

b_1. Clypeus viewed from the side nearly straight, protruding (fig. 16) .... *S. vallicolens* Chamberlin

Spirembolus spirotubus

Fig. 17. Tibial apophysis of male palpus. 18. Cephalothorax, lateral view.

Spirembolus monticolens

Fig. 19. Male palpus, to show tibial apophysis.

Spirembolus spirotubus

Fig. 20. Palpal organ, ventral view.

b_2. Clypeus viewed from the side distinctly concave below the anterior median eyes (fig. 13) .... *S. synopticus*, new species

a_2. Femur of palpus unarmed at tip.

b^1. Tibial apophysis without a tooth on the mesal side. (fig. 19) .... *S. monticolens* Chamberlin

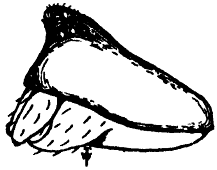
b^2. Tibial apophysis with a distinct tooth on the mesal side. (fig. 17).

c_1. Head abruptly elevated behind (fig. 15) .... *S. perjucundus*, new species

c_2. Head more gradually elevated (fig. 18) .... *S. spirotubus* (Banks)

7. **Spirembolus synopticus** Crosby, new species

Male: Cephalothorax brown, with radiating lines. Seen from the side the dorsal line ascends evenly to the posterior eyes with scarcely any depression at the cervical groove. Anterior median eyes projecting forward. Clypeus broad, nearly perpendicular, evenly and distinctly concave (fig. 13).



Spirembolus synopticus

Fig. 13. Lateral view of cephalothorax. 14. Male palpus to show tibial apophysis.

Posterior row of eyes gently recurved; the median eyes slightly nearer to each other than to the lateral; anterior row procurved, the median much nearer to each other than to the lateral. Sternum and labium nearly

black. Endites yellow, mottled wih grey; large and very broad at the tip with a hardened ridge on the edge next to claw of the chelicera. Sternum separating the hind coxæ by less than their length and squarely truncate behind.

Legs yellow, palpi paler; tibia, metatarsi and tarsi of the first legs, and tibia and metatarsi of second, armed on the outside with a series of short forward-curved hairs. Abdomen grey. Palpus has the femur nearly as long as the rest of the palpus. At the meso-distal angle there is short white round-pointed process. Tibial apophysis very long, and curved, with a strong sharp tooth on the mesal side (fig. 14).

Length, 2 mm.

Holotype: Cornell Univ., ♂ ; *Paratype,* M. C. Z., ♂.

Type locality: Berkeley, California, Nov., 1919. Three males taken by sifting. (Henry Dietrich). *Other locality,* Stanford, California, 1920-21. One male from branches of pine. (J. C. Chamberlin).

When Banks described *Tiso spirotobus* he mentioned another species from Washington state. I found in the Museum of Comparative Zoology a specimen from Olympia, Washington, which is doubtless the one to which he referred. It is a specimen of *S. synopticus.*

8. **Spirembolus perjucundus** Crosby, new species

Male: Cephalothorax brownish with darker radiating lines; viewed from above evenly rounded on the sides and broadly rounded in front, not constricted at the cervical groove; viewed from the side, the dorsal outline is arched to the cervical groove, where there is a distinct depression. Head strongly elevated, rounded over the top to the anterior median eyes; clypeus very wide, nearly vertical in the upper part, protruding below (fig. 15). Posterior eyes in a gently procurved line, the median nearer to the lateral than to each other. Anterior eyes in a strongly procurved line, the median much smaller than the lateral, subcontiguous, and widely separated from the lateral. Anterior median eyes higher than the posterior median. Ocular area clothed with short stiff hairs directed upward and backward. Sternum dark grey over brown; endites brownish yellow, mottled with grey. Legs and palpi light brownish yellow, the legs abundantly clothed with short curved hairs.

Abdomen dark grey or black. Palpus with the femur nearly as long as the rest of the segments combined, the patella half as long as the femur,

and the tibia, including the apophysis, as long as the patella. Femur not armed on the inner angle with a white process. Tibial apophysis very long and slender, armed on the mesal side with a distinct tooth. Palpal organ similar to that of the other species.

Length, 1.7 mm.

Holotype: M. C. Z., No. 1250, ♂; *Paratype,* Cornell Univ., ♂.

Type locality: San Gregorio Beach, San Mateo Co., California, 1920-21. (J. C. Chamberlin). *Other locality:* Berkeley, California, Nov., 1919. (Dietrich).

Genus **Tortembolus** Crosby, new genus

Head of male elevated into a large lobe which does not bear the eyes, and provided with postocular pits. Palpal organ similar to that of *Spirembolus.* The embolic division of the spiral type. There are three full turns of the spiral and the basal part forms part of the coil.

Genotype: *T. tortuosus* Crosby, new species.

I would also place in this genus *Dismodicus alpinus* Banks and *Lophocarenum fasciatum* Banks (of which *Diplocephalus castigatorius Crosby* is a synonym). In *Dismodicus bifrons* Blackwall, the type of that genus, although the head of the male is elevated in much the same way as in Tortembolus, the palpal organ is of a different type. Tortembolus is distinguished from Spirembolus Chamberlin by the form of the head and the presence of postocular pits; the palpal organ is of the same type in both genera.

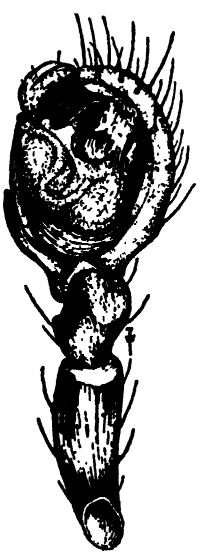
KEY TO THE SPECIES OF TORTEMBOLUS, MALES

a_1. Abdomen distinctly marked with alternating light and dark transverse bands.................*fasciatus* (Banks)
a_2. Abdomen not distinctly banded.
  b_1. Tibial apophysis short and broad.....*alpinus* (Banks)
  b_2. Tibial apophysis long and slender.
    c_1. Epigastric plates very finely striate...............................*tortuosus,* new species
    c_2. Epigastric plates coarsely striate...................................*demonologicus,* new species

9. **Tortembolus tortuosus** Crosby, new species

Male: Cephalothorax greyish brown with the margin and the radiating lines darker. Cephalic lobe paler with a fine greyish longitudinal line in the middle. Viewed from the side, gradually ascending to the cervical groove; head elevated into a very large rounded lobe which does not bear the eyes. It is slightly retreating in front so that it partly overhangs the

Fig. 21



Tortembolus tortuosus

Fig. 21. Cephalothorax, lateral view. 22. Palpal organ, ventral view. 23. The same, lateral view.

posterior median eyes, and is bounded on each side by a distinct groove in which there is a small round pit back of and above the posterior lateral eye. Clypeus nearly vertical and slightly convex (fig. 21). Posterior eyes when viewed directly from above gently recurved, the median about their diameter from the lateral and a little farther from each other. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by radius of median.

Sternum grey over brown, smooth and shining. Endites yellowish marked with grey. Hind coxæ separated by nearly their length. Legs brownish yellow. Front tarsi and metatarsi equal. Abdomen grey. The epigastric plates small, and widely separated by soft integument; the striations very fine; the stridulating tooth on hind coxæ well developed.

Femur of palpus compressed and somewhat keeled below; patella about two thirds as long as femur; except at base, as broad as femur; tibia short but armed with a very long, slender apophysis which ends in a minute recurved hook opposite the angle on the back of the tarsus; the paracymbium is broad and flat and bent into a rounded hook; basal part of the embolic division a broad coiled band, after one turn it becomes a black coiled rod; there are three complete turns to the spiral; tip supported by a membranous conductor, lying near a pointed process (figs. 22 and 23).

Length, 1.1 mm.

Holotype: M. C. Z., No. 1251, ♂; *Paratypes,* M. C. Z., Cal. Acad. Sci., and Cornell Univ.

Type locality: Stanford, California, 1920-21. Three males. *Other locality,* Mayfield, California, October 30, 1920. Several males. (J. C. Chamberlin).

10. **Tortembolus demonologicus** Crosby, new species

Male: Cephalothorax greyish brownish yellow, with the radiating line and the margin darker. Viewed from above, rounded on the sides and scarcely, if at all, constricted back of the eyes. Cephalic does not overhanging the posterior median eyes, which are fully visible when viewed from directly above, marked over the top with a double grey line. Viewed from the side, ascending evenly to base of cephalic lobe, which is very high and rounded over the top, not retreating in front above the eyes. Clypeus convex (fig. 24).

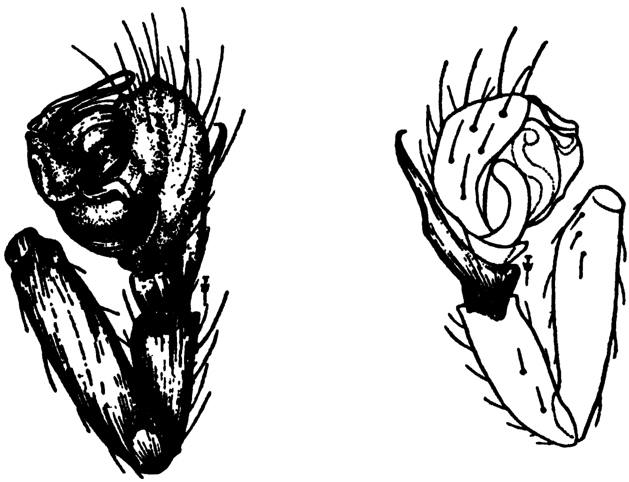
Posterior eyes in a gently recurved row, the median a little farther from each other than from the lateral. Anterior eyes in a gently recurved row, the median smaller, subcontiguous, separated from the lateral by nearly the diameter of the median. Sternum grey over brown, darker towards the margin, smooth and shining. Endites brownish yellow tinged with grey. Hind coxæ separated by less than their diameter. Legs and palpi pale yellowish, palpal organ closely resembling that of *T. tortuosus,* but the terminal coil of the embolus not so long, and the basal part of the embolic division narrow (figs. 25 and 26).

Abdomen grey, a light line on each side beneath; epigastric plates broadly separated by grey integument; striations coarse, there being only five or six transverse lines.

Length, 1.3 mm.

August 14, 1925

Fig. 24



Tortembolus demonologicus

Fig. 24. Cephalothorax, lateral view. 25. Palpus, mesal view. 26. The same, ectal view.

Holotype: Cornell Univ., ♂ ; *Paratypes,* M. C. Z.

Type locality: Berkeley, California, December, 1919, (Dietrich). *Other locality,* Mayfield, California, October 30, 1920. Two males. (J. C. Chamberlin).

11. **Neriene redacta** Chamberlin, new species

Male: Cephalothorax elongate and conspicuously narrowed caudad, dusky fulvous, without definite markings; legs fulvous, a little dusky; abdomen blackish, formed much as in *coccinea,* strongly constricted at middle.

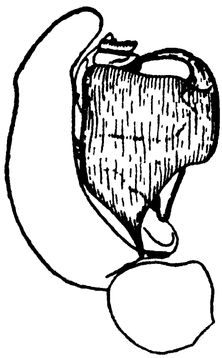
Chelicera with a stout tooth at proximal end toward mesal side; femur of palpus on proximal half with a patch of conspicuous cusps on ventral and mesal sides; palpal organ as shown in fig. 27.

Length, 3 mm.

Holotype: M. C. Z., No. 1095, ♂.

Type locality: Punta Gorda, Florida.

This species, while resembling in size and general appearance *N. coccinea* (Hentz), differs rather widely in the structure of the palpal organ, in the presence of the cusps on the



Neriene redacta
Fig. 27. Left palpus of male, mesal view.

femur of the palpus, etc. It is closer to *N. clathrata* (Sundewall) in the structure of the palpus, though this is clearly distinct in the form of the tegulum, etc. It is different in the more pronounced constriction of the abdomen and in its smaller size.

12. **Neriene dogmatica** Chamberlin, new species

Male: Carapace blackish brown, the color deeper along margin, but with no definite markings. Proximal half of femur of palpi yellowish, distal half and the more distal joints blackish. Femora of all legs yellow at proximal end, elsewhere dusky, more or less streaked with yellow. Tibiæ with a dark annulus at distal end and one near middle commonly incomplete, three annuli, typically obscure, on anterior legs. Metatarsi with dark annulus at distal end and a much larger one in middle region; the posterior tarsi in particular may show a submedian annulus. Abdomen nearly black everywhere excepting in a light stripe over each anterolateral corner and caudad a little beyond middle, this stripe with white or silvery spots anteriorly. In the palpus the patella wholly lacks a

process and the tibia is simply extended distally on the dorsomesal side but shows no true apophysis. Details of the bulb shown in fig. 28.

Length, 4.2 mm.

Neriene dogmatica

Fig. 28. Right palpus of male, mesal view.

Holotype: M. C. Z., No. 1109, ♂.

Type locality: Jasper Ridge, San Mateo Co., California. Winter of 1920-21. Joseph C. Chamberlin. One adult and one immature male.

This species is placed in Neriene because of its palpal characters rather than on the basis of the eyes, the eyes of the posterior row differing but little in size. It may be distinguished from *clathrata, redacta,* and the others, in the form of the tegulum, which lacks a distal process, and in other details of the palpus.

13. **Micronetа evadens** Chamberlin, new species

Male: This is a small species having both cephalothorax and abdomen dusky, without markings, and the legs yellow.

Cephalothorax considerably longer than wide; eye-region elevated; clypeus depressed below eyes and slanting slightly forward to base of

chelicerae, convex from side to side. Chelicerae straight; lower margin with a series of four small teeth, the upper margin with a series of six or seven.

The species is clearly characterized by structural features of the palpus. The tibia is elevated above segment to tarsus and bears on the caudal surface of the elevation a caudally directed tooth. The cymbium bears a

Microneta evadens
Fig. 29. Right palpus of male, dorsoectal view.

short rounded process at its caudal end and mesodistad of this a longer, apically somewhat uncate process. The paracymbium is furcate at its outer end, the lower prong being long, as shown in fig. 29.

Length, 1.8 mm.

Holotype: M. C. Z., No. 1103, ♂.

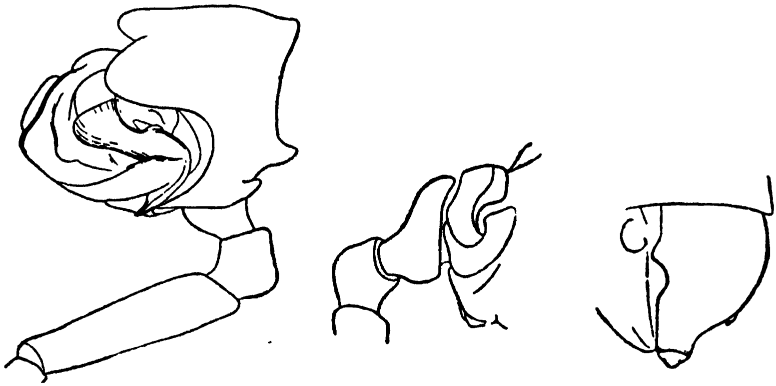
Type locality: Wellesley, Massachusetts. One male taken in May.

14. **Bathyphantes wana** Chamberlin, new species

Male: This species seems to stand apart, with *B. micaria* Emerton, from other North American species in the form of the chelicerae and palpi. The chelicerae are strongly narrowed at distal ends, above which, in side view, they appear to bulge strongly. Fig. 32. Each chelicera is armed near middle on anteromesal surface with a distinct tooth. The palpus is superficially characterized by having two processes or horns on the dorsum of the cymbium toward its base on the inner margin. See fig. 30.

Carapace, sternum and cheliceræ dusky. Legs yellowish. Abdomen dusky, somewhat paler above but without definite markings, or at most with faint suggestion of cross marks.

Length, 2.8 mm.

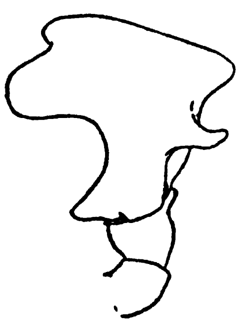


Bathyphantes wana

Fig. 30. Right palpus of male, mesal view. 31. Tibia and basal part of tarsus of same, ectal view. 32. Right chelicera, ectal view.

Holotype: M. C. Z., No. 1097, ♂; *Paratypes,* M. C. Z., No. 1098.

Type locality: Oyster Bay, New York. *Other localities,* Three Mile Id., Lake Winnepesaukee, New Hampshire, May 29, 1906; Long Id., Maine, May 17, 1904; Ithaca, New York, pasture near Lake Beebe, July 31, 1909.



Bathyphantes micaria

Fig. 33. Paracymbium and tibia of male palpus, ectal view.

This species has been heretofore confused with *B. micaria* Emerton. In the latter the upper part of the chelicera is less thickened and in lateral view notably less convex. A character of particular importance is that the cymbium of the male palpus in *micaria* has only one process, which is longer and more curved than either of the two present in *wana* (fig. 33). The distal end of the tibia in the male palpus has a process or elevation but is narrower and shorter.

15. **Bathyphantes dentichelis** Chamberlin, new species

Male: A species placed tentatively in Bathyphantes, though not typical in a number of characters. It resembles certain species of Neriene (Linyphiella as typified by *coccinea* Hentz) in the elongate cephalothorax which is narrowed conspicuously behind the middle and also in front of it. The abdomen is narrowed at front end and is moderately constricted at the middle, so that the animal as a whole suggest some of the ant-like forms. Clypeus, as viewed from above, convex from side to side; de-

Bathyphantes dentichelis
Fig. 34. Right palpus of male, ectodorsal view.

pressed below the eyes. Posterior row of eyes straight or slightly procurved; the medians a little larger than the laterals, nearer to each other than to the latter; lateral eyes on each side contiguous, prominent; anterior median eyes small, close together, much farther from the laterals. Cheliceræ of male distinguished by being armed down the anterior face

with a series of fine conspicuous teeth, much as in species of Erigone; constricted distally adjacent to base of claw; a prominent tooth on ventral margin of furrow near base of claw and directed distad. Legs long and slender; with few or no spines; metatarsus I a little shorter than Tibia I.

Carapace dusky. Legs flavous. Abdomen blackish with a light-colored annulus about the median constriction.

Palpus, fig. 34.

Length, 2 mm.

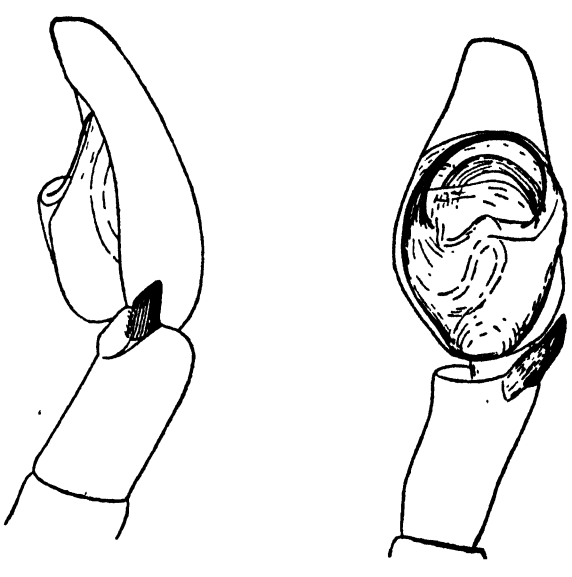
Holotype: M. C. Z., No. 1096, ♂.

Type locality: New Orleans, Louisiana.

THOMISIDÆ

16. **Philodromus syntheticus** Chamberlin, new species

Male: Carapace fulvous, dusky on the sides and on posterior end of pars cephalica. Clypeus crossed by two vertical bands composed of dense, fine black dots; cheliceræ also densely dotted on front face. Sternum and



Philodromus syntheticus

Fig. 35. Left palpus of male, ectal view. 36. The same, ventral

coxæ of legs beneath, yellow; legs yellowish, marked with black; the patellæ, femora, tibiæ and metatarsi with numerous black dots, those on tibiæ and metatarsi tending to condense in bands at the ends and also at middle in case of the metatarsi. Abdomen with the usual spear-shaped black mark at base followed behind by two longitudinal black marks on each side of middle, these converging caudad and uniting in front of spinnerets. Sides of abdomen finely dotted with black, the venter immaculate.

Anterior row of eyes slightly recurved; eyes subequal; median eyes a little more than their diameter apart, less than their diameter from the laterals; posterior row of eyes strongly recurved, the eyes equidistant; area of median eyes narrower in front than behind. Palpus, figs. 35 and 36.

Length, 5 mm.

Holotype: M. C. Z., ♂.

Type locality: Patagonia, Arizona, May, 1913. R. V. Chamberlin.

In the greater length of the second legs this species is among those suggesting Ebo, but the relations of the eyes separate it from that genus.

LYCOSIDÆ

17. **Pardosa heretica** Chamberlin, new species

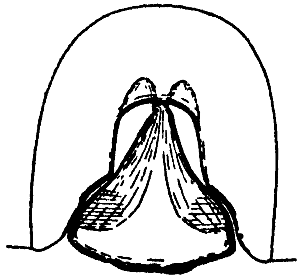
Female: Under alcohol the carapace appears nearly black excepting for the median light stripe behind the eyes which is as wide as the eye area; sternum blackish brown; legs also blackish or blackish brown, lighter distally; abdomen blackish above, somewhat lighter along the middle, the venter lighter as usual.

Anterior row of eyes much shorter than the second, procurved; median eyes decidedly larger than the laterals, more than their radius apart and about an equal distance from the laterals. Upper margin of furrow of chelicera with three teeth, the lower with but two, which are large. Epigynum, fig. 37.

Length, 6 mm.

Holotype: M. C. Z., ♀.

Type locality: Patagonia, Arizona. R. V. Chamberlin coll.



Pardosa heretica
Fig. 37. Epigynum.

Readily distinguished in having only two teeth on lower margin of furrow of chelicera but three on the upper margin as in Lycosa, and in the peculiar form of the epigynum.

Oxyopidæ

18. **Oxyopes classicus** Chamberlin, new species

Female: Carapace brown with the usual median dorsal lighter stripe and a vertical light line on clypeus widening below. Sternum yellow at the middle and brown at the sides. Labium nearly black, the endites brown. Legs brown, the femora darkened and other joints annulate.

Oxyopes classicus
Fig. 38. Epigynum.

Venter of abdomen with a median longitudinal dark band, each side of which it is light from numerous fine yellow dots on a duller, more greyish background.

Abdomen broad anteriorly, more robust than in *salticus*, with caudal end abruptly narrowing to an acute point. The species seems easily distinguishable from *O. salticus* Hentz, aside from different details of coloration, in the form of the epigynum, the forwardly projecting process of which is rounded at the end and parallel-sided, not acute (fig. 38).

Length, 8 mm.

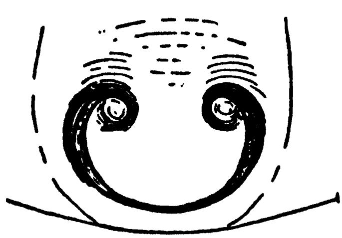
Holotype: M. C. Z., ♀.

Type locality: Altoona, Florida. One female.

19. **Oxyopeidon haytianum** Chamberlin, new species

Female: In general size and appearance this species resembles *O. cubanum*. It differs in the form of the clypeus, which is more nearly vertical and is not so conspicuously convex and curved back at its lower end. It differs also in the form of the abdomen, which is high behind, with the posterior declivity descending almost vertically to the spinneretes.

Carapace light chestnut, clothed with narrow white scales; chelicerae



Oxyopeidon haytianum

Fig. 39. Epigynum.

similar; sternum and legs yellowish; abdomen ventrally light and without markings; dorsum clothed with brown and white scales. Anterior eyes rather more widely separated than in *cubanum*, with the median nearer to each other than to the laterals instead of equidistant. Epigynum, fig. 39.

Length, 7 mm.

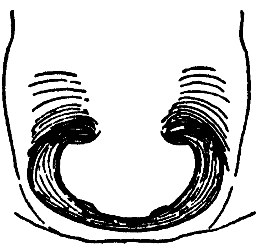
Holotype: M. C. Z., No. 1189, ♀.

Type locality: Hayti. One female. Crew coll.

20. **Oxyopeidon communicans** Chamberlin, new species

Female: This species differs from *haytianum* in having the carapace higher behind just in front of the posterior declivity than in the eye-region instead of having the dorsal line descend gradually caudad.

Carapace brown, somewhat dusky on the sides and clothed with white scales. Sternum and coxæ of legs beneath yellow. Legs fulvous or light brown, vaguely annulate with dark. Abdomen slender, regularly narrowing caudad from middle, the dorsal line evenly descending, not more



Oxyopeidon communicans
Fig. 40. Epigynum.

abruptly bent at caudal end; a black spear-shaped mark at base above and some black chevron lines behind; the sides also blackish; the venter pale, marked with one or more black lines. Eyes of anterior row equidistant; no transverse depression above the anterior row of eyes. Epigynum, fig. 40.

Length 5.5 mm.

Holotype: M. C. Z., No. 1190, ♀.

Type locality: Hayti. One female. Crew coll.

21. **Oxyopeidon cubanum** Chamberlin, new species

Hamataliwa grisea Banks (not of Keyserling), in part, Second Rep. Cent. Exp. Sta. Cuba, 1909, p. 167.

Female: Integument of carapace fulvous, dusky over sides and clypeus; sternum yellowish; chelicerae clothed with white scales. Legs fulvous, in part somewhat dusky, the metatarsi obscurely triannulate and in life it is possible that other joints may have showed annuli. Abdomen dark in a mark at base and over sides; also in a longitudinal median

ventral band; it is wholly denuded of hair at present and the markings as in life cannot be determined.

Anterior row of eyes strongly recurved, eyes equidistant, the laterals greatly exceeding the medians, as usual. Posterior row of eyes strongly

Oxyopeidon cubanum
Fig. 41. Epigynum.

procurved, with the medians two-thirds as far from the laterals as from each other. Abdomen conspicuously pointed behind over posterior third of its length, but without distinct lateral tubercles. Epigynum, fig. 41.

Length, 6 mm.

Holotype: M. C. Z., No. 1187, ♀.

Type locality: Santiago de las Vegas, Cuba. Baker coll. One female.

22. **Oxyopeidon tuberculatum** Chamberlin, new species

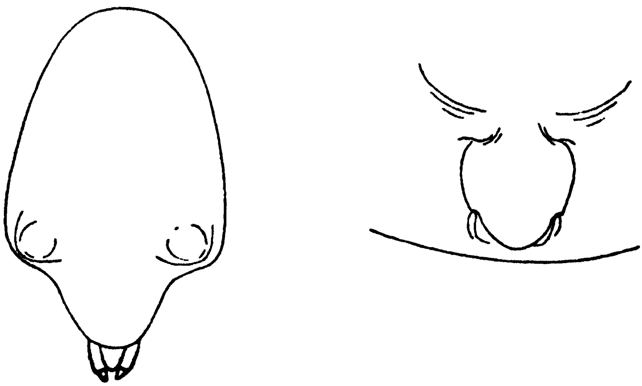
Hamataliwa grisea Banks (nec Keyserling), in part, Second Rep. Cent. Exp. Sta. Cuba, 1909, p. 167.

Female: The specimen has been too long preserved to show color markings at all clearly. At present the entire carapace is a uniform dusky fulvous and is clothed with scales that appear dark. Sternum and legs yellowish, with femora of the latter dusky; annuli may have been present in fresh specimens but they do not show at present. No definite markings are now apparent on abdomen.

Head strongly transversely furrowed or depressed above eyes, the depression more sharply pronounced than in *cubanum* with which the eyes nearly agree in their relations. The abdomen is pointed behind as in

cubanum, but is characterized by the presence of a conspicuous tubercle on each side just in front of the narrowing caudal region. Epigynum, fig. 43.

Length, 4.6 mm.



Oxyopeidon tuberculatum
Fig. 42. Abdomen. 43. Epigynum, probably not quite mature.

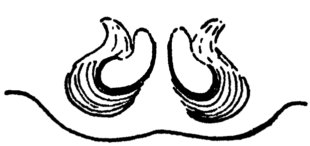
Holotype: M. C. Z., 1188, ♀.

Type locality: Santiago de las Vegas, Cuba.

SALTICIDÆ

23. **Sitticus synopticus** Chamberlin, new species

Female: Under alcohol the carapace shows a distinct median longitudinal light stripe extending from a light area in the ocular region caudad and down the posterior declivity; black each side of the median stripe; sides light excepting a black marginal line; sternum and legs



Sitticus synopticus
Fig. 44. Epigynum.

flavous, unmarked. Abdomen yellow below; dorsum dark at the sides with a median light stripe enclosing a lanceolate dark mark anteriorly, from which two lines extend out on each side to the dark area.

Tibia I has below two pairs of spines and a single spine at anterior end; one spine on anterior face; tibia II has three spines under posterior border and a single spine on anterior face. Epigynum as shown in fig. 44.
Length, 5.5 mm.; cephalothorax, 3 mm.

Holotype: M. C. Z., 1057, ♀.

Type locality: Sausalito, Cal. R. V. Chamberlin coll.

Genus **Anicius** Chamberlin, new genus

Resembles Wala in general appearance but differs in having a compound, two-cusped tooth on the lower margin of the furrow of the chelicera. Cephalothorax relatively a little longer and more nearly parallel-sided. Quadrangle of posterior eyes wider than long, as wide in front as behind, shorter than thoracic division. Anterior row of eyes with line of upper edges a little recurved, nearly straight. Tibia I with three pairs of spines beneath; tibia II with two seriate spines beneath as in Icius. Abdomen slender, narrowed caudad. First legs much heavier and longer than the others and the fourth clearly exceeding the third.

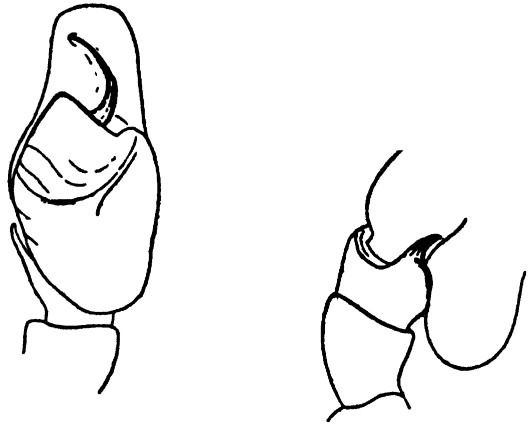
Genotype: *Anicius dolius,* new species.

24. **Anicius dolius** Chamberlin, new species

Male: In general light in color. A band of white hair along each side of carapace above a darker border. Palpi and first legs blackish, strongly contrasting with the three last pairs of legs, which are light yellow, much as in Wala. Abdomen with two longitudinal bands of white hair corresponding to those of carapace; the intervening dorsal region bordered with a deep-colored line on each side, a dark median band sending out branches to these lines, herring-bone like, and clothed with iridescent scales; venter with three dark longitudinal lines combined with each other at ends, a lighter stripe along each side.
First legs much heavier and longer than the others. Palpus, fig. 45.
Length, 4 mm.; cephalothorax, 1.8 mm.

Holotype: M. C. Z., No. 1066, ♂.

Type locality: Guadalajara, Mexico. One male.

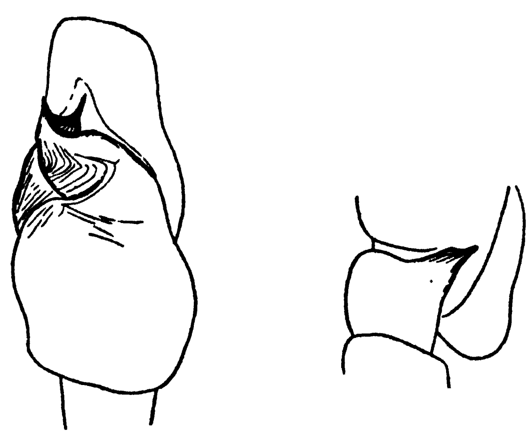


Anicius dolius

Fig. 45. Right palpus of male, ventral view. 46. Tibia and basal part of tarsus of same, ectal view.

25. **Phidippus pogonopus** Chamberlin, new species

Male: Carapace with integument brown, rubbed bare in type; clypeus bearing long, greyish-brown hair; chelicerae green in front. First legs heavily fringed beneath; the fringe of femur long, black excepting proxi-



Phidippus pogonopus

Fig. 47. Right palpus of male, ventral view. 48. Tibia and base of tarsus of same, ectal view.

mally where white; fringe of patella black on ectal half, white on mesal; fringe of tibia black excepting a few white hairs at proximal end; fringe of metatarsus white on proximal portion, black on distal; fringe of tarsus white; the other legs are also fringed ventrally, the fringe becoming more sparse from second to fourth legs. Integument of abdomen dorsally showing a light band at base ending squarely at middle where each angle is extended laterally; an oblique light line on each side of this basal mark and behind it two transverse light lines on each side; a clothing of light grey or white hair over anterior face and back on the sides, some being also still present on middorsal region though here most are rubbed off the type specimen. Integument of venter paler but clothed with fine, longer black hair. Palpus, figs. 47 and 48.

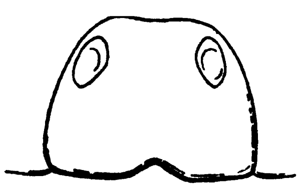
Length, 9 mm; cephalothorax, 4.5 mm.

Holotype: M. C. Z., 1069, ♂.

Type locality: Green River, Utah, 1921. R. V. Chamberlin Jr. One adult male and one immature specimen.

26. **Phidippus molinor** Chamberlin, new species

Female: Integument within ocular area reddish, elsewhere on the carapace of a duller color, black about eyes; carapace clothed with light grey hair, uniform, without distinct bands; clypeus densely clothed with white hair; white hair also on upper part of cheliceræ. Legs brown, hair



Phidippus molinor
Fig. 49. Epigynum.

grey, with the usual longer dark setæ. Integument of dorsum of abdomen chocolate colored, with an H-shaped light mark in anterior region, the cross-piece extended caudad at middle; a pair of light spots behind the H-mark and farther behind two oblique lines on each side proceeding from the light area of the sides; sides crossed with broken oblique bars of chocolate color; venter with a median dark stripe, the lateral parts

light; abdomen clothed with whitish hair or scales like those of carapace and legs, this hair apparently denser on the light areas of integument.

Epigynum, fig. 49.

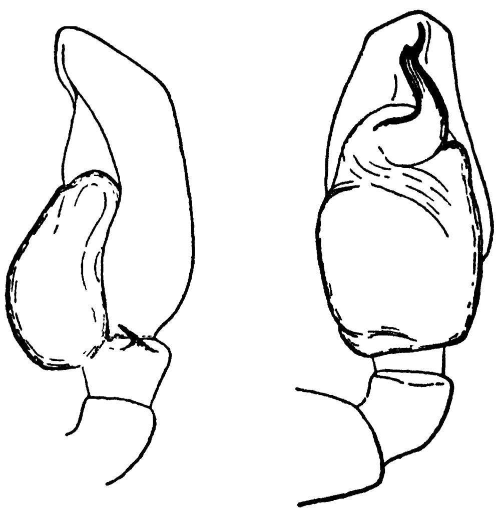
Length, 7.8 mm.

Holotype: M. C. Z., No. 1071, ♀.

Type locality: Mill Creek Canyon, Utah. One female. R. V. Chamberlin.

27. **Dendryphantes mylothrus** Chamberlin, new species

Male: Integument of both cephalothorax and abdomen dark, nearly black. On carapace a band of white hair along each side back of the posterior eye and extending to and down the posterior declivity; a trans-



Dendryphantes mylothrus

Fig. 50. Left palpus of male, ectal view. 51. The same, ventral view.

verse band of white hair behind posterior eyes, with white hair also back of anterior eyes. Legs blackish throughout excepting tarsi or tarsi and metatarsi which are less dusky. Abdomen very dark, a band of white hair about anterior end and caudad along the sides with some also dorsally but with no distinct markings on dorsum shown by type.

The species is characterized particularly by the form of the embolus which, while distally suggesting that of *D. capitatus*, is clearly different

in the longer and decidedly curved proximal portion. See further figs. 50 and 51.

Length, 5.5 mm; cephalothorax, 3 mm.

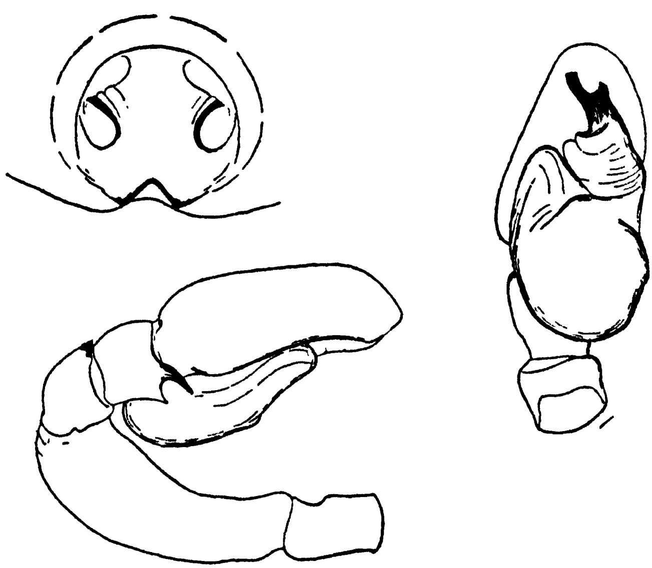
Holotype: M. C. Z., No. 1055, ♂.

Type locality: Mill Creek Canyon, Utah. R. V. Chamberlin coll.

Females from the same locality and perhaps belonging with this male specifically are in coloration and general structure apparently very close to *capitatus* and *æneolus,* the epigynum being of the same type as in the latter species.

28. **Dendryphantes mimus** Chamberlin, new species

Male: Coloration much as in *sausalitanus;* carapace similarly dark and with a broad band of white hair on each side; legs similarly but not so strongly darkened. Abdomen with median region darker, bordered with a lighter stripe on each side, the sides and lateral portion of dorsum dark excepting for a light band around anterior end and extending back



Dendryphantes mimus

Fig. 52. Epigynum. 53. Right palpus of male, ventral view. 54. The same, ectal view.

on each side to spinnerets; dorsum without markings or with some paler chevron marks obscure.

Cheliceræ small, vertical. Spines under tibia, I, 3-3, with those under the posterior border much more widely separated than the anterior ones.

Palpus short, with the tarsus comparatively large as in *sausalitanus* rather than as in *melanomerus* and *mathetes;* embolus furcate as in *capitatus* but the main branch straight and truncate at the end (figs. 53 and 54).

Length, 4 mm; cephalothorax, 2 mm.

Female: What is presumably the female of this species differs in color from the male in having the legs yellow and unmarked with dark, or the posterior pairs with an obscure annulus at distal end of joints; carapace lighter above; white bands of sides uniting and covering posterior declivity; head in eye region clothed with grey hair and dark ones intermixed; clypeus and upper part of cheliceræ clothed with white hair. Abdomen with a median longitudinal pale stripe bordered on each side, with a more or less interrupted dark band in which are some deeper spots, the median region enclosing a herring-bone mark which extends nearly to spinnerets; a light band across anterior end and extending caudad on each side to spinnerets.

Epigynum, fig. 52.

Length, up to 6 mm. when abdomen is extended; cephalothorax, 2 mm.

Holotype: M. C. Z., 1047, ♂; *Allotype,* M. C. Z., 1048, ♀; *Paratypes,* M. C. Z.

Type locality: Pecos, New Mexico. R. V. Chamberlin.

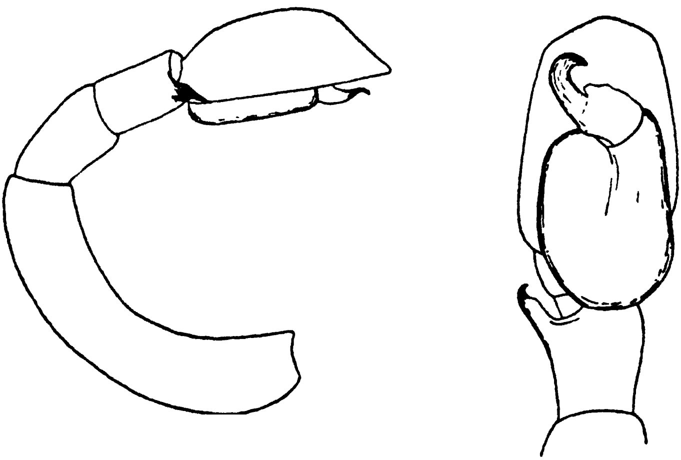
Other locality: Del Norte, Colorado.

29. **Dendryphantes apachecus** Chamberlin, new species

Male: Carapace dark. The type is too much rubbed to determine character of the original hair covering accurately, but it obviously had normally white hairs on the sides and posterior declivity of carapace, these being denser along the lateral borders. Cheliceræ black. Femora of legs dark, the color of the first ones deepest, black or nearly so; other joints lighter, but the patellæ and tibiæ, especially of the anterior pairs, more or less dusky. Integument of dorsum of abdomen black along each side, leaving a paler median stripe over entire length which encloses a dark lanceolate mark in its anterior two thirds; a white stripe across anterior end and back along each side; lower part of sides dark, the midventral region paler.

Cheliceræ oblique, the claws rather long and somewhat sinuous. Palpi slender, the tarsus small. Bulb and apophysis as shown in figs. 55 and 56. Characterized readily by the form of the embolus.

Length, 4.2 mm; cephalothorax, 2 mm.



Dendryphantes apacheeus

Fig. 55. Right palpus of male, ectal view. 56. The same, more enlarged, ventral view.

Holotype: M. C. Z., No. 1051, ♂; *Paratype*, M. C. Z., No. 1052.

Type locality: Precise locality uncertain, but possibly Thatcher, Arizona. R. V. Chamberlin, 1913. *Other locality,* Ft. Collins, Colorado. R. V. Chamberlin, 1904.

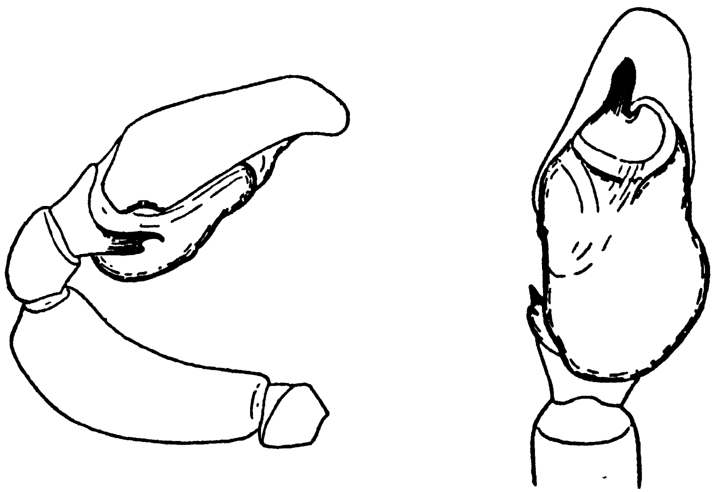
30. **Dendryphantes sausalitanus** Chamberlin, new species

Male: A broad band of white hair below eyes on each side and extending caudad to posterior declivity, some white hairs also above eyes of first row and mesad of others. Femora entirely black, or, posterior ones in particular, paler at proximal end; patellæ black distally; tibiæ entirely dark or, on posterior legs, with the dark color tending to condense into a broad band; metatarsus dark distally, the color tending to diffuse in anterior legs; tarsi pale; tarsus of palpus dark, with some white scales above; coxæ of legs pale. Sternum blackish. Abdomen wholly dark excepting for the usual light band across anterior end and part way back

on sides; the dorsum in the two types showing no markings, or, in one, with vague traces of paired spots of white hair.

Cheliceræ small, only a little oblique. Spines of antior tibiæ as usual. Palpus, figs. 57 and 58.

Length, 4.2 mm.; cephalothorax, 2 mm.



Dendryphantes sausalitanus

Fig. 57. Right palpus of male, ectal view. 58. The same, more enlarged, ventral view.

Holotype: M. C. Z., No. 1045, ♂; *Paratype,* M. C. Z., No. 1046, ♂.

Type locality: Sausalito, California, 1909. R. V. Chamberlin coll.

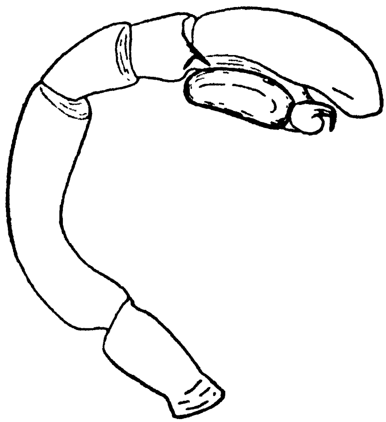
In general appearance suggesting *æneolus,* but readily distinguished from that and related species in the peculiar notched tibial apophysis of the male palpus and the form of the embolus.

31. **Dendryphantes mathetes** Chamberlin, new species

Male: Carapace dark; clothed along lateral borders with a band of white hair narrowing forward as in *melanomerus,* the upper part of carapace in the type rubbed so that character of its clothing cannot be ascertained. Legs colored as in *melanomerus.* Cheliceræ dark, the anterior face black. Abdomen dark below and on sides; a narrow light

band around anterior end and extending caudad on each side to or behind middle; two light lines corresponding to those in *melanomerus* but these meeting at an angle on the dorsum and preceded by, more or less confluent with, a second chevron which in turn is preceded by a pair of light marks, the middorsal region appearing light caudad to spinnerets.

Spines under tibia I, 3-3, the posterior three a little more widely spaced than the anterior ones; spines under tibia II, 1-3.



Dendryphantes mathetes

Fig. 59. Right palpus of male, ectal view. 60. The same, ventral view.

Chelicerae of ordinary size, oblique, the claws more sinuous and more uniformly narrowing distad than in *melanomerus*.

Palpus, figs. 59 and 60. The form of the embolus is distinctive. The palpus is heavier and its tarsus larger than in *melanomerus*.

Length, 3.5 mm.; cephalothorax, 2 mm.

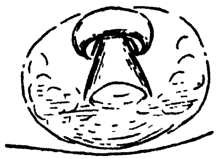
Holotype: M. C. Z., No. 1043, ♂ ; *Paratype,* M. C. Z., No. 1044, ♂.

Type locality: Claremont, California, 1909. R. V. Chamberlin coll.

32. **Pellenes contingens** Chamberlin, new species

Female: Integument of carapace blackish; clothed with grey hair, and with the usual longer dark bristles. Clypeus white, with a dark oblique stripe beginning at each anterior median eye. Legs also clothed with grey. Abdomen clothed with grey hair; a band of white across anterior end; two

white transverse or oblique marks on each side of dorsum, one near and one behind middle, a median white spot between the levels of these two and a smaller one behind it; venter clothed with lighter, nearly white hair.



Pellenes contingens
Fig. 61. Epigynum.

Tibia I with three pairs of spines beneath. Tibia II with four spines beneath, one at distal end under anterior border and three under posterior border, of which the distal may apparently be sometimes absent. Epigynum, fig. 61.

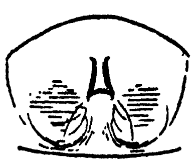
Length, 7 mm.; cephalothorax, 3 mm.

Holotype: M. C. Z., No. 1064, ♀; *Paratype,* M. C. Z., 1065, ♀.

Type locality: Guadalajara, Mexico.

33. **Pellenes grammaticus** Chamberlin, new species

Female: Integument of carapace darkest, blackish, on head, a lighter band on each side of dorsal part of thorax; clothed with greyish hair; no definite bands detectable, though the specimen is considerably rubbed. Clypeus clothed with white hair, with no darker markings. Legs with



Pellenes grammaticus
Fig. 62. Epigynum.

integument strongly annulate with black, the blackish color more or less diffused on anterior legs on joints proximad of the metatarsi. Integument of the abdomen dark, nearly black above, with a median herring-bone stripe over its entire length, this stripe fulvous, and also light marks on the sides; dorsum rubbed nearly bare, but whitish hair is present over

anterior surface and back along sides; venter clothed with light grey or whitish hair, the integument beneath being mottled with dark.

Tibia I with five spines beneath, two under anterior border and three under the posterior, the distal two of these paired with the corresponding anterior ones. Tibia II with four spines, one at distal end under anterior border and three under posterior border of which the distal one is reduced. Epigynum, fig. 62.

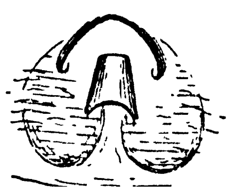
Length, 6 mm.; cephalothorax, 2.8 mm.

Holotye: M. C. Z., No. 1068, ♀.

Type locality: Thatcher, Arizona, 1913. R. V. Chamberlin.

34. **Pellenes leuceres** Chamberlin, new species

Female: Carapace clothed with light grey or whitish hair throughout, with no bands or markings. Clypeus with a dense clothing of white hair excepting for an oblique dark band under each anterior median eye. Legs



Pellenes leuceres
Fig. 63. Epigynum.

also clothed with hair like that of carapace. Abdomen clothed throughout with light grey or whitish hair like that of carapace, the venter a clearer white. Epigynum, fig. 63.

Length, 6.5 mm.; cephalothorax, 3.2 mm.

Holotye: M. C. Z., No. 1063, ♀.

Type locality: Auburn, Alabama, July, 1909. R. V. Chamberlin.

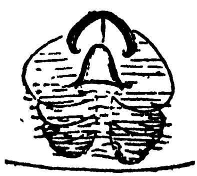
This species suggests *sabulosus* Peckham, but differs in the more uniform coloring of hairs of thorax and abdomen which lack the distinct bands and spots. It has similarly oblique lines on the clypeus, but these are black instead of chestnut. The epigyna are very similar.

35. **Pellenes neomexicanus** Chamberlin, new species

Female: Carapace clothed throughout with grey hair, showing no distinct markings. Clypeus clothed with white hair, with no trace of dark spots or bands. Legs yellow, clothed with white scale-like hairs. Abdomen rubbed bare; the integument dark, with oblique light stripes up the sides; venter yellow.

Tibia I very short, bearing below four spines, one under anterior border and three in series under posterior border. Tibia II also with four spines beneath arranged as on tibia I. Epigynum, fig. 64.

Length, 7 mm.; cephalothorax, 2.5 mm.



Pellenes neomexicanus
Fig. 64. Epigynum.

Holotype: M. C. Z., 1067, ♀.

Type locality: Albuquerque, New Mexico. R. V. Chamberlin.

In form of epigynum suggesting *P. carolinensis,* but readily distinguished by different color markings, spining of legs, etc.

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VIII

ANATOMY OF LANX, A LIMPET-LIKE LYMNÆID MOLLUSK

BY

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In a recent paper, Dr. Henry A. Pilsbry[1] pointed out that the genus Lanx differed from the Ancylidæ in the position of the apex of the shell, in the absence of a distinct pseudobranch, and in the Lymnæid form of the jaw and dentition. For these reasons, he decided that the Lancidæ should be separated as a family, with Lymnæid rather than Ancylid affinities.

About the same time, Dr. G. Dallas Hanna, Curator of Paleontology, California Academy of Sciences, wrote me that he had specimens of Lanx with the animal, originally preserved in formalin, and very generously put them at my disposal. One lot, from which the dissections were made, consisted of seven specimens of *Lanx alta* (Tryon) from Klamath River (on rocks in swift water), Klamathon, California, collected by G. A. Coleman (Nov. 13, 1924). Although considerably retracted and stiffened by the formalin, they made very satisfactory material for dissection. The other set consisted of smaller and somewhat lower specimens (slightly approaching *Lanx subrotundata*) from Rogue River, 6 miles south of Grants Pass, Oregon, collected by G. D. Hanna (Nov. 15,

[1] 1925, Naut. XXXVIII, 73-75.

1924); it was used in the preparation of a second series of transverse sections. The identifications were made by Dr. Pilsbry, whose many helpful criticisms were of greatest assistance. The dissections were worked out and figured at the Zoölogical Laboratory of the University of Pennsylvania.

Especial acknowledgment is due Dr. Eleanor Carothers, of the same laboratory, for the preparation of two very valuable series of transverse sections. As those cut from a Rogue River specimen show less maceration than the series from typical *Lanx alta*, the former are used for some of the histological figures, but only in cases where the essential structure is the same in both forms. The series are stained with alum-cochineal and counter-stained with orange G.

In order to facilitate comparison of the figures made from different animals, the measurements in millimeters are given below for the shells of the individuals studied.

		Length	Width	Height	
Klamath River;	No. 1	15.9	77 (12.3)	50 (8.1)	Figs. 2-4, 16
	No. 2	14.5	75 (10.9)	50 (7.2)	Figs. 5, 6, 14, 15
	No. 3	13.0	76 (9.9)	48 (6.2)	Figs. 7-13, 17-19, 21
	No. 4	12.9	72 (9.3)	45 (5.8)	Figs. 23, 24
	No. 5	12.8	79 (10.1)	52 (6.6)	Fig. 1
	No. 6	12.2	79 (9.6)	54 (6.6)	
	No. 7	11.1	83 (9.2)	54 (6.1)	
Rogue River;	No. 8	9.3	82 (7.6)	43 (4.0)	Figs. 20, 22, 27

Eleven specimens, from some of which the animals were taken for dissection, are in the collection of type material of the California Academy of Sciences where they bear Nos. 1783-1794. Others from the same lots have been deposited in the Academy of Natural Sciences of Philadelphia.

Like the shell, the body is broadly conical, with the apex distinctly in front of the center and slightly to the left (fig. 2). The dorsal side of the cephalic end shows transverse wrinkles between and around the bases of the broadly triangular tentacles, just in front of which are the rather prominent eyes. The male sex-opening is an inconspicuous orifice at the bottom of a conical depression, just behind the posterior end of the right tentacle (fig. 1). The roughly crescentic ventral surface of the head is covered with coarse bosses; the

T-shaped mouth is on a prominence a short distance in front of the groove which borders the foot.

The foot is large and has a very thick, muscular sole, well adapted for attachment to rocks in swift water. Its sides are somewhat wrinkled, due to the retraction, but are otherwise quite smooth and lightly pigmented. Its epidermis is a simple columnar epithelium, while its interior contains a rather loose network of interlacing muscle-fibers. Just above the sole (F, fig. 11), the interspaces are filled with masses of mucous cells, but above this denser zone is a much broader one with numerous sinuses (S, fig. 11). The female sex-opening appears as a prominent longitudinal slit with thick lips, in the upper portion of the right side of the foot, about ⅓ the body-length from the anterior end of the animal (fig. 1).

When the shell is removed (fig. 2), the cut ends of the columellar muscle-fibers appear as a white band which completely surrounds the visceral dome, except for a small gap (sometimes closed dorsally) just above the lung. Immediately behind this gap, a stout column of muscle (M, fig. 3) is separated from the remainder of the ring ventrally, but partially fuses near the shell. All of the muscle-strands descend ventrad from the shell (or scar) as a dense mass (M, fig. 11), to spread out widely between the sinuses of the foot. This is a very different arrangement from the three columns of muscle in *Hebetancylus moricandi* (von Ihering; 1891, Bull. Sci. France-Belg. XXIII, fig. iv-8).

The visceral dome inside of this columellar ring is covered by a very thin, darkly-pigmented, but slightly translucent membrane, which practically consists of a single layer of flattened cells; this is fused to the inside of the ring a short distance below the attachment of the latter to the shell. Outside of the muscle-scar, the mantle forms a broad, continuous, jet-black band, covered with concentric wrinkles (figs. 8-10), and margined with white at its free border. This band is slightly narrower on the left side (appears much more so in fig. 2, due to the steeper slope of the left side) and is slightly notched at the center of its anterior end. The epidermis of this black band consists of simple columnar epithelium which is full of very opaque pigment. The outer, white band develops higher, but

non-pigmented cells (figs. 8-10); below these, numerous neurocytes suggest that this zone has a sensory function.

The thick, muscular, free mantle juts out some distance all around the foot. Under its edge is a thickened fold (fig. 1), which forms the special organ for aëration; this is heaviest just behind the gap in the muscle-ring and decreases in prominence in both directions until it is practically obsolete at the anterior mantle-notch. The large sinuses in this fold (S, figs. 8-10) are drained by two mantle veins which join, opposite the muscle-gap, to form the principal pulmonary vessel or vena cava. The common opening of the lung and hind-gut is a little to the right of the posterior end in the very edge of the mantle (A, figs. 1-3). The lower side of the free mantle is covered by a simple columnar epithelium similar to that of the foot. Although clumps of nerve cells are quite frequent in this vicinity, I am unable to distinguish a definite "osphradium" in any of my preparations, unless the plications of the cavity behind the confluence of the lung and hind-gut (A, fig. 8) represent such a structure.

The lung is clearly vestigial and must play practically no role in respiration. It is roughly comma-shaped (broken lines, fig. 2), with the point of the comma at the confluence with the hind-gut and the elongate dot across the front of the visceral dome (Z, fig. 11), mainly behind the pericardium. Its lining consists of a single layer of very flat cells (fig. 7) and does not appear to be associated with any special blood-spaces. The enormous pericardium (fig. 6) lies between the lung and the anterior region of the muscle-ring (H, fig. 2). The renopericardial orifice (X, fig. 6) is opposite the middle of the ventricle of the heart. The elongate kidney lies (K, fig. 2) above the lung parallel to the pericardium. The lumen of the main portion is rendered complexly sacculate (fig. 6) by cords and trabeculæ (K, fig. 11) of the same rather low, columnar cells that form its lining; these partitions disappear as the kidney passes gradually into the ureter (U, fig. 9), which is also surrounded by similar epithelium. These renal epithelia (fig. 7) are characterized by the peculiar position of the nuclei near the luminal ends of the cells and by the rather large vacuoles nearer their outer ends; the tissue appears to have a marked

affinity for the orange G but practically none for the red stain. Inside of the mantle, the ureter (U) is about half as large as and lies laterad to the lung (Z, fig. 10), into which it opens (fig. 9) about 2 mm. above the confluence of the latter with the hind-gut (fig. 8).

From the above, it will be seen that the pallial complex of Lanx is Lymnæid in its general plan, and has nothing in common with that of the Ancylidæ; even the gill-like fold is of quite different character from the pseudobranch of the latter family. In comparison with *Lymnæa stagnalis*[2] and *Lymnæa reflexa*[3], the reduction in size of the lung is not out of proportion to that of the entire visceral mass. However, the lack of venation and the confluence with the hind-gut appear to indicate that the lung of Lanx plays a relatively unimportant part in the aëration of the blood. In addition, the entire visceral dome and the pallial cavity appear to be twisted posteriad and to the right, as if the spire had more than uncoiled; the position of the shell-apex slightly to the left and in front of the center also seems to indicate a slight degree of hyperstrophy. As will be described below, this torsion is accompanied by a peculiar dislocation of the visceral and abdominal ganglia (fig. 16).

Attention is also called to the fact that, in many features, the arrangement of the pallial complex shows a remarkable parallelism with that of the Veronicellidæ[4], in which group the "lung" appears to have degenerated even more completely into a sort of secondary ureter. *Protancylus pileolus* Sarasin[5] also has a common opening for the lung and hind-gut, but this is near the middle of the left side of the body; this last species develops a left pseudobranch, quite like that of the Planorbidæ and Ancylidæ, in addition to blood-sinuses in the right mantle[6].

The thick-walled ventricle (fig. 6, 11) is very large, and heart-shaped, with the point (aorta) towards the left side and the emarginate border towards the right. The auricle is much more slender and has very thin walls. The preservation of the

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[2] Pilsbry; 1900, Proc. Acad. Nat. Sci. Philadelphia, LII, fig. xvii-2.

[3] F. C. Baker; 1911, Chicago Acad. Sci., Sp. Publ. 3, pl. I.

[4] Sarasin; 1899, Land-Moll. Celebes, figs. xiv, 124-127 and Pelseneer, 1901, Mem. ac. r. Belg. LIV, 21-26, figs. vi-49, 52-55.

[5] 1898; Süssw.-Moll. Celebes, 86-88, pl. xiii.

[6] op. cit., figs. 170, 177.

specimens impedes a detailed study of the arterial system, but the main aorta does curve ventrad, pass under the bursal sac and bifurcate to form a cephalic aorta which goes first to the gizzard, and a visceral (intestinal) aorta with large branches to the genitalia and visceral mass. The pulmonary vein (vena cava), which passes through the muscle gap, is formed by the confluence of the two mantle veins and vessels from the sinuses of the foot. The large "right" mantle vein drains the sinuses of the posterior and sinistral portions of the gill-fold, while the smaller "left" one comes from the limb along the anterior portion of the right mantle edge.

This circulatory system appears quite like that of *Lymnæa emarginata mighelsi*[7], but the pulmonary network is practically lacking and the mantle veins are correspondingly enlarged. The enormous relative size of the heart in *Lanx alta* must insure a rapid circulation of the blood, which would compensate in part for the reduction in area of the aërating membranes and the apparent dependence on dissolved oxygen. However, it is just possible that the animal can breathe air, as I found bubbles in the lung of one preserved specimen. The pallial complex and mantle fold of the Rogue River form are very similar to those of typical *Lanx alta,* but the lung and ureter occupy a relatively larger portion of the free mantle while the aërating sinuses are correspondingly smaller.

As already mentioned, the closed mouth (fig. 1) of Lanx is T-shaped and opens on the ventral side. The cross-bar of the T is reinforced dorsally by the principal jaw, while the lateral sides of the longitudinal slit are strengthened by the two, so-called accessory jaws. The last (fig. 24) are simply vaguely-outlined thickenings of a general, "horny" stratum that covers the margins of the mouth and is continuous with that of the true jaw. This median jaw (fig. 24) is broadly crescentic with the cutting margin slightly emarginate, either side of the middle, so as to form a slight median projection. Its upper side is finely striate at right angles to the cutting margin, while its inner side is strengthened by a crescentic thickening which runs parallel to the imbedded edge.

[7] F. C. Baker; 1900, Bull. Chicago Acad. Sci. II, pl. vi.

The radular formula of *Lanx alta* is about 16-6-1-6-16; the transverse rows are almost straight in the central and lateral fields, but are directed obliquely anteriad in the marginal region. The small central (fig. 23) is asymmetrical and bicuspid, with a stout, aculeate, major cusp and a left minor one. The large 1st lateral has a small base and a large, squarish, very thin, bicuspid reflection; the major cusp (mesocone) has a low entoconal angulation and a higher one on the ectoconal side. The ectocone itself is small, acuminate, and sometimes slightly hooked. The other lateral teeth are slightly smaller and the entoconal wing becomes higher until the 7th tooth is distinctly tricuspid. The marginal teeth have very small bases and elongate reflections; usually the 9th develops another entoconal notch which on the 10th separates a distinct cusp. The remainder of the teeth are practically all 4-cusped, although one or two of the minute outermost ones commonly develop more points.

Through the generosity of Dr. Pilsbry, I have been able to examine radulæ mounted by him from *Lanx subrotundata* (Tryon), *L. patelloides* (Lea), and *L. (Walkerola) klamathensis* Hannibal. A radula of *L. subrotundata* from Elkton, Oregon (A.N.S.P. 78630) has very similar inner teeth to those of *L. alta*, but all of the marginals could not be counted in the specimen examined. The radular formula of specimens of *L. patelloides* from Redding, California (A.N.S.P. 72741), is about 12-6-1-6-12. The teeth in the three radulæ examined are all very similar to those of *L. alta* and have the same asymmetrical, bicuspid centrals; while the occasional presence of another minor cusp on the latter[8] would not be extraordinary, I doubt whether the central is ever symmetrical. The radular formula of *L. (Walkerola) klamathensis* from Upper Klamath Lake, California (A.N.S.P. 113843), is about 15-6-1-6-15. The teeth are very similar to those of *L. alta*, but the minor cusp of the central is slightly reduced and the bases of the laterals are a little larger in proportion to the reflection. Walker's figure (1918, fig. 53) clearly shows these characters, but the smaller number of teeth (12-5-1-5-12) suggests that his radula is from a younger or smaller animal.

[8] Walker; 1918, Univ. Mich. Mus. Zool., Misc. Coll. 6, fig. 51.

A radula of *Lanx (Fisherola) lancides* (Hannibal) from a dried specimen (A.N.S.P. 113838), collected in the Snake River at Lewiston, Idaho, by H. Hemphill (1911) shows a quite different dentition. The radular formula is 28-8-1-8-28 and the rows are shaped somewhat as in *L. alta*. The minor cusp of the asymmetrical, bicuspid central (fig. 25) is almost obsolete. The laterals have much smaller reflections and the mesocone and ectocone are connected by a thin shelf which commonly develops two weak and extremely variable cusplets. This shelf decreases in prominence on the outer laterals, while the entoconal wing becomes higher, until the 9th tooth has only one vestigial cusplet between the ectocone and mesocone but shows a distinct entocone. Beyond the 9th, each marginal has a rather short reflection which bears three cusps: a subspatulate mesocone, a small, sharp entocone, and a larger, pointed ectocone. One or two of the minute outermost teeth often develop additional cusplets, but the tricuspid condition is maintained with remarkable uniformity through most of the marginal series. The median jaw (fig. 26) of this species is much thinner and more elongate than that of *L. alta;* the lateral thickenings show signs of their derivation from a plaited condition.

Superficially, the buccal mass of *Lanx alta* (fig. 4) is a large, ovoid body, from which the short, blunt radular pouch projects, slightly below the center of the posterior end. Several minor protractor muscles are present, but long retractors appear to be lacking. The two, small, light-colored, amorphous, salivary glands (S) are above the œsophagus but extend anteriad around both sides of the buccal mass; their ducts enter the substance of the mass and empty into the dorsum of the pharynx, either side of the gullet. Histologically, they consist of small alveoli composed of vacuolate cells, which are remarkably similar in appearance to those of the mucous glands of the foot.

The flattened ventral portion (B. fig. 22) of the buccal cavity is roofed by the radular membrane (R), which curves around the anterior end of the radular cartilage. The last is a large, bilobed structure (C) with large spaces between the anastamosing trabeculæ of harder substance (fig. 27). Ven-

trad and anteriad (R, fig. 22), it presents a smooth, even curve, over which the radula is slightly convex, while dorsad, it develops a U-shaped grove (U), into which the radula is concavely folded. This groove is continuous with the almost cylindrical radular pouch, which lies between the two, bluntly-rounded, posterior horns of the cartilage. The pharynx (P) is not separable from the buccal cavity; both are lined by simple columnar epithelium which is somewhat lower than that of the epidermis. Under the radular membranes, this epithelium becomes still lower, so that it consists of a layer of practically cuboid cells.

The oesophagus opens out of the dorsal side of the pharyngeal portion of the buccal cavity just opposite the anterior end of the radular cartilage; at first, it is enclosed in the walls of the buccal mass above the radular pouch (G, fig. 22), but appears superficially (G, fig. 11) on the posterior end of the mass. From here, it extends to the gizzard, which lies a little behind and to the left of the center of the animal. No sharply demarcated crop is present, but the posterior end of the gullet is externally thrown up into longitudinal ridges and would appear to be adapted for considerable distension. The rather thin walls of the oesophagus are mainly composed of a layer of very high, darkly-staining, columnar cells, which internally form coarse, longitudinal folds that increase in prominence towards the gizzard.

The entire stomach is obliquely tilted dorsad, with the elongate, cone-shaped, thin-walled pylorus above and twisted first to the right and then abruptly to the left. The gizzard is bilobed as in Lymnæa[9], has extremely thick, muscular walls, and contains rounded bits of sand, diatom shells, pieces of tubular algae and much unidentifiable material. The upper end of the pylorus receives two large ducts (L, figs. 4, 5) from the anterior and posterior lobes of the liver. Its very tip, beyond these ducts, is slightly separated by a weak constriction and bears ventrally (posteriad) a small, ovoid diverticulum. (In another specimen, this is considerably longer than in D, fig. 5). This pouch is lined by high, columnar epithelium, very similar to that of the pylorus and gizzard.

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[9] F. C. Baker; 1900, figs. iv, C-E.

From the stomach, the intestine (fig. 3) runs almost to the left side (where it appears on the dorsal surface of the visceral mass), then bends across the anterior border of the liver (just under the edge), loops through the posterior portion of this digestive gland to return to the anterior border at the right side, where it turns abruptly downward, and passes posteriad along the left side of the lung to the posterior opening of the common cavity (A, figs. 8, 9, 10). Like all of the digestive tract, the intestine is lined by simple columnar epithelium; this is slightly lower in the first limb than in the fourth, but is lowest in the fifth limb or hind-gut, which, however, has clumps of higher cells that form the plicæ. Besides the slender columnar cells with dense, darkly-staining cytoplasm, there occur larger, rounded goblet-cells with large vacuoles; in the hind-gut (fig. 12), these are mainly restricted to the higher folds. As already mentioned, the lung (Z, fig. 10) joins the hind-gut (A) a short distance above the common opening; in this region, the cavity is enlarged, very coarsely plicate, and lined by higher, columnar epithelium somewhat similar to that of the epidermis.

The bilobed liver or pancreas forms an alveolate, lenticular mass which almost covers the posterior ¾ of the visceral mass. The small anterior (L, fig. 3; morphologically right?) lobe lies above the gizzard and between the first two limbs of the intestine, while the much larger posterior (morphologically left?) portion lies between the first, third and fourth limbs, extends slightly outside of the last and invades the base of the free mantle (L, fig. 10) through the muscle-gap; this invasion is greater in a Rogue River specimen and may be due in part to the retraction of the animals studied. The large hepatic alveoli are mainly composed (fig. 13) of very large columnar cells (liver cells) with large vacuoles, around the small, sub-basal nuclei, and more opaque globules in the cytoplasm near the lumen of the gland. These principal cells are interspersed with clumps of lower, more rounded cells (lime-cells) with much larger nuclei and denser cytoplasm. These two types stand out very distinctly in the stained sections as the liver cells are colored yellow, while the lime cells are bright red.

The genitalia (fig. 14) are bulkier than all of the remainder of the viscera taken together. The ovotestis is larger (T, fig. 3) than the liver, but is mainly imbedded beneath the latter. It is also irregularly lens-shaped with an emarginate anterior margin, is light yellow in color, and consists of complexly intertwined series of cords with closely-packed alveoli, like excessively attenuate bunches of raisins[10]. These all lead into an ovoid sac a little back of the center of the mass. All of the individuals examined, regardless of their size (see above), appear to be sexually mature; the spermatozoa are much more conspicuous than the ova (note dates of collection).

The anterior portion of the ovisperm duct, just behind the ovoid sac, is slender and naked, but the major portion is covered by a dense mass of large, very thin-walled alveoli, which are closely packed into the right side of posterior end of the ovotestis and actually appear on the dorsal surface of the visceral mass between the third and fourth limbs of the intestine (D, fig. 3). The cavities of these sacs are crowded full of spermatozoa and must act as seminal vesicles or reservoirs. In the ovotestis, the sperm are grouped with their heads together in disc-shaped masses, each of which lies against a large cell somewhat similar to the Sertoli cells of vertebrates, but, in the reservoirs, they are quite irregularly massed, although they still tend to lie parallel to each other. The ovisperm duct itself bifurcates on the surface of the carrefour; one twig goes to the seminal duct while the other develops a small spherical body (talon?) and enters the carrefour itself.

The oviduct may be divided into four regions: (1) the carrefour[11]; (2) the prebulbar oviduct; (3) the bulbous enlargement; and (4) the postbulbar or vaginal portion; in addition, it develops two glandular diverticula: (1) the albumen gland; and (2) the oviducal diverticulum or "nidamental gland." The carrefour or spermoviduct (uterus of authors) receives the ovisperm duct and that of the albumen gland; it is a narrow, transversely sacculate and complexly plicate tube which lies between the head of the false prostate and the base of the albumen gland. Its walls are almost entirely composed of a simple epithelium which varies in height from the very slender,

[10] Cf. F. C. Baker; 1900, fig. iii-F.
[11] Lacaze-Duthiers; 1899, Arch. Zool. Exp. (3) VII, 110.

columnar cells of the plicæ, to the almost cuboid ones of the intermediate regions. The albumen gland is gray in color, semicircular and considerably flattened; it lies under the ovotestis towards the left (right in a Rogue River specimen) side of the floor of the hæmocœle. The sections show it to be divided into numerous alveoli which are lined by a single layer of rather low, columnar cells that stain a bright red and are superficially similar in appearance to those of the oviducal bulb but contain much larger vacuoles and larger nuclei (fig. 21).

The oviducal diverticulum or "nidamental" gland (second accessory albuminiparous gland of F. C. Baker, 1911) is an ovoid body which opens at the junction of the carrefour and prebulbar oviduct. Both in gross and histological structure, this body looks like a small edition of the oviducal bulb; its lumen is similarly reduced by numerous laminæ, which are composed of two layers of columnar cells that are stained a brilliant red in the serial sections.

The prebulbar portion of the oviduct is a rather stout tube, with a few, coarse, internal plicæ. The simple columnar epithelium which composes the main portion of its wall (fig. 20) consists of remarkably large cells with small, basal or central nuclei and numerous, clear vacuoles, which, under low magnification, give this tissue the very distinctive appearance of delicate lace-work. Outside of these gland-cells is a very thin layer of squamous cells with scattered muscle-fibers.

The oviducal bulb or uterus is a pear-shaped enlargement which is sharply demarcated from the preceding tube but tapers rather gradually into the postbulbar portion. While somewhat flattened, it does not show as prominent a longitudinal groove as does the "first accessory albuminiparous gland"[12] in most species of Lymnæa. In *Lanx alta,* this groove is actually a thin region of the wall (fig. 14-A); if the bulb is split lengthwise along this line, the closely-packed, laminate plications of the remainder of the wall can be spread out like the leaves of a book and are seen to be oblique to the long axis of the organ. These plicæ consist of a double layer of the simple columnar epithelium which lines the bulb; the dense

[12] F. C. Baker; 1911, pl. x-xv.

cytoplasm of its large cells are stained a brilliant red in the serial sections. This tissue must be very similar to that which composes the folds of the "third division of the oviduct or uterus"[13] in *Lymnæa ovata.* Outside of the epithelium, the walls develop a very thin layer of fibrous tissue and squamous cells.

The postbulbar or vaginal portion of the oviduct is similar in diameter to the prebulbar tube, although it is slightly enlarged just above its confluence with the bursal stalk. Its thick walls are largely composed of circular muscle, although varying amounts of longitudinal fibers are usually gathered into two groups on opposite sides of the tube. The deeply plicate lumen (fig. 14-B) is lined by a comparatively thin, rather featureless, simple columnar epithelium.

The stalk of the bursa (spermatheca) is rather slender, although very slightly enlarged near its base, and lies along the dorsal side of the bulbar and postbulbar portions of the oviduct. Its terminal sac, which is imbedded (B, figs. 3, 11) near the left side of the hæmocœle, is roughly heart-shaped and very large. In addition to the thin outer layer of fibrous cells, both stalk and sac have a lining of very peculiar, simple columnar epithelium, which is thrown up into weak plications (B, fig. 11). The cells of this tissue (fig. 18) are very slender; their cytoplasm is dense and stains rather darkly, but the large, subcentral nuclei are markedly vacuolate, so as to give to a tangential section somewhat the appearance of the cartilage of vertebrates. The luminal ends of these cells are produced into anastamosing, ameboid masses from which separate roughly globular pieces of what appears to be the cytoplasm of the cell itself. The spacious lumen of the bursal sac contains many of these corpuscular structures[14] in a mass of granular material; this leads me to suspect that the bursa is actually a gland which secretes some sort of thick, viscous material as an aid in copulation. The vagina proper, beyond the confluence of the bursal stalk and the oviduct, is very short, almost obsolete, but the peculiar form and heavy walls of the postbulbar oviduct give it much the appearance of the vagina of some of the terrestrial pulmonates.

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[13] J. Klotz; 1889, Jena. Zeitschr. Nat. XXIII, figs. ii-11, 17.
[14] Cf. Lacaze-Duthiers; 1899, fig. iv-9.

The very long and tortuous seminal duct can be divided into six rather distinct regions: (1) the first or false prostate; (2) the very short duct between the first and second prostates; (3) the second or true prostate; and (4, 5, 6) the first free, the imbedded, and the second free portions of the extremely long vas deferens. Ventral to the carrefour, the first prostate begins as a flattened, plicate, fan-shaped, blind sac; the portion below the entrance of the ovisperm duct forms an elongate, flattened, irregularly-lobed body which is folded into a compact mass near the left side of the body below the oviduct. (In a Rogue River specimen, it is on the right side and the blind end extends through the muscle-gap into the base of the mantle.) Its flattened lumen (fig. 14-C) is much more spacious and its walls correspondingly thinner than those of the true prostate. The columnar cells (fig. 19) which line the cavity have small nuclei surrounded by large vacuoles which restrict the cytoplasm to very thin trabeculæ; often the luminal ends of several cells support a large bubble of transparent secretion. Unlike the vacuolate cells of the albumen gland (fig. 21), these on the male side are but slightly stained in the serial sections. Like most parts of the reproductive system, the outside of the organ is covered with a very thin layer of pigmented cells; these give the surface of this glandular sac an areolate appearance.

The second or true prostate is roughly tongue-shaped and lies (P, fig. 3) just anterior to the oviducal bulb. It consists of an enlargement of the seminal duct, lined by ciliated, cuboid epithelium, and surrounded by closely-packed, radiating, tubular glands (fig. 14-D). Each of these secretory pouches is made up of large rounded cells with their long axes parallel to that of its very small central lumen, so that a transverse section of a tubule shows five or six at one time. The nucleus of each cell (fig. 17) is on the side opposite the lumen of its pouch and the cytoplasm is crowded with rather large, quite dense globules. The structure of this prostate must be quite similar to that of *Lymnæa ovata*, although the published figures[15] do not show the lumina of the tubules or the cell boundaries.

[15] Klotz; 1899, figs. ii-12.

Below the prostate, the first free portion of the vas deferens is rather stout and quite long; it is coiled near the right side of the hæmocœle, mainly anteriad to the oviduct and bursal stalk. The imbedded section is somewhat narrower and scarcely convoluted; it passes out through the muscle-gap and runs along the outside of the columellar muscle-ring (1, fig. 11) from the base of the oviduct to that of the penis. The second free portion extends in a tortuous course through the hæmocœle (H. fig. 3) over to the left side of the body and back again to enter at the apex of the penis; although narrower than the first free portion, the greater part of its length is quite stout and thick-walled. The last few millimeters, which are mainly coiled around the penis and under the anterior pallial nerve, are considerably narrowed, so that their convoluted lumen is visible through the walls. The entire vas deferens is lined by a single layer of ciliated, cuboid epithelium. Outside of this is a thick envelope of circular muscle, usually with two groups of longitudinal fibers on opposite sides but rather close to the epithelial lining. I am unable to detect any gland cells outside of the epithelium; those figured from the vas deferens of *Lymnæa ovata*[16] look very much like cross-sections of longitudinal muscle but they are represented as much larger than the circular fibers in the same figure.

The entire male copulatory organ, termed here the penis, is very similar to that of *Lymnæa*[17]; that is, it consists of an elongate-ovoid, preputial portion (penis-sac) and a somewhat constricted *hyperphallus* (penis, F. C. Baker) with a faint terminal knob. The hyperphallus (fig. iii-15) or capsule of the verge is not sharply demarcated externally from the remainder of the penis and is about ¼ the total length of the organ. Its walls are rather thin and contain numerous sinuses which give them somewhat the appearance of erectile tissue. The hyperphallar lumen is almost completely filled by the elongate, pointe, penial papilla or verge (glans or penis of authors), which is probably the only portion that penetrates the vagina of the female. The vas deferens, with its convoluted lumen, enters the base of the verge; the continuation of the sperm canal, which extends to the very tip, is quite narrow and cir-

[16] Klotz; 1889, fig. ii-14.
[17] F. C. Baker; 1911, pl. x-xv.

cularly plicate. This arrangement appears quite similar to that in *Lymnæa ovata*[18]. The larger sac of the penis has rather thick, solid, muscular walls, which internally develop transverse plications and two large pilasters (fig. 14-E), that certainly resemble those of *Lymnæa auricularia*[19]. The penis is lined by high, columnar epithelium which extends up into the cavity of the hyperphallus.

The main body of the penis receives two branched muscles on its anterior side and three on its posterior. A slip (cut in fig. 14) from the upper of the anterior two, is attached to the apex of the hyperphallus so that, in my retracted specimens, this structure is bent back on the anterior side of the larger sac of the penis. The posterior muscles extend to the base of the thickened column of muscle behind the gap in the columellar ring.

This origin of the hyperphallar retractor from an anterior muscle appears to be quite different from the arrangement in *Lymnæa*[20], but it must be remembered that, in *Lanx alta*, all of these muscle bands arise from some part of the columellar muscle-ring. Otherwise, the genitalia are so similar to those of *Lymnæa* that they might almost pass for those of a species of that genus, although the enormous size of the ovotestis and the seminal reservoirs would appear to be rather distinctive.

On account of the stiffness of the organs, which prevent their safe manipulation without rupture, the study of the nervous system from my material is especially difficult. The general arrangement appears quite similar to that of *Lymnæa stagnalis* and *L. peregra*[21] and to that of *L. reflexa*[22], but the ganglionic ring is concentrated along the long axis of the body and stretched transversely to the right (fig. 16). This dextral distortion, which especially affects the visceral-abdominal complex, has already been correlated with the posterior position of the common pulmonary and anal opening.

The cerebral commissure is rather long. Each cerebral ganglion is roughly triangular, with enlargements (lobes) at each corner. The nerves from the left one are: acoustic,

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[18] Klotz; 1889, figs. ii-15, 16.
[19] Hugo Eisig; 1869, Zeitschr. Wiss. Zool. XIX, figs. xxv-8, 9.
[20] F. C. Baker; 1911, pl. x-xv.
[21] Lacaze-Duthiers; 1872, Arch. Zool. Exp. I, pl. xvii.
[22] F. C. Baker; 1911, pl. v.

optic (O, fig. 16), tentacular (T), superior frontolabial (L), middle labials (C), nuchal (N) and the subcerebral commissure (X; satellite of anterior labial artery). In addition, the right one gives off the penial and hyperphallar (H); these can be separated almost to their bases and appear to branch off just below a special, ridge-like enlargement of the ganglion. The cerebrobuccal connectives are rather long, but loop transversely so that the buccal ganglia are quite close to the cerebral (moved away in my figure). These buccal or stomatogastric ganglia are relatively large and give off at least the radular (R), deep pharyngeal, lateral pharyngeal and anterior pharyngeal branches; the last sends a twig (S) to the salivary glands along their ducts.

The cerebropleural connectives are very short so that the pleural ganglia are closely approximated to the cerebral. The left pleurovisceral connective is relatively long but the right visceral and pleural ganglia are in close juxtaposition. Each visceral ganglion gives off an anterior (M) and a posterior (P) pallial nerve; those of the right side are larger. The left visceral is closely united to the abdominal ganglion, although a distinct, stout connective is present between the latter and the right visceral. The abdominal ganglion gives off the subintestinal (G; genital), the aortic (A; anal), a root to the right anterior pallial, and one or two minute nerves to the body wall.

The cerebropedal and pleuropedal connectives are short and stout, but the pedal commissure is a little longer. The pedal ganglia are large and not greatly affected by the dextral distortion of the abdominal complex. Each gives off six sizable branches: superior (K) and inferior (I) cervicals, superior (D, anterior), central (E) and inferior (F, posterior) pedals and a columellar (U). The otocysts are near the anterior ends of the dorsal surfaces of the pedal ganglia.

The general shape and buried position of the eyes is quite similar to that in *Lymnæa stagnalis*[23], but a large sinus surrounds the outer half of each; it forms a rather large cavity between the thin corneal epithelium and the inconspicuous layer of connective tissue which underlies the thickened epidermis.

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[23] Simroth; 1876, Zeitschr. Wiss. Zool. XXVI, fig. xv-12.

This sinus is so large and the overlying epidermis and subdermis so opaque (in preserved specimens) that a small, rounded boss is the only superficial indication of the position of each eye. The lens is large and the pigmented layer very thick, especially at its inner end, but the outer fibrillar processes of the retinal cells are poorly developed except in a little cup directly behind the center of the lens. The optic nerve is quite widely separated from the tentacular one.

In the posterior portion of each tentacle, the transverse sections show the presence of a small, sensory pocket, with a groove which runs posteriad and ventrad from it. On the ventral side of this pocket is a mass of ganglionic tissue. The retracted condition of my specimens prevent the accurate description of the shape of this structure, as the deep folds of the tentacle obscure its position. Mucous glands, similar to those in the foot, are present in and around the base of the tentacles. My failure to find a definitely localized osphradium or organ of Lacaze-Duthiers has already been reported.

These anatomical data all substantiate Dr. Pilsbry's demonstration that Lanx is a derivative of the Lymnæidæ and is not closely related to the Ancylidæ. As Dr. Pilsbry has often pointed out, the terrestrial pulmonates appear to have a constantly recurrent tendency to produce slug-like forms. A similar propensity in the Basommatophora seems to lead towards ancyliform shells and bodies. In the Lancidæ, specialization of the other organs has not gone so far as in the Ancylid derivatives of the Planorbidæ; in fact, it is very remarkable that Lanx combines such profound changes of external form with such trifling divergencies in the internal anatomy, especially in that of the genital and digestive systems.

On the basis of much of the anatomy, Lanx could scarcely be separated from the Lymnæidæ, but its peculiar modification of the pallial complex appears to be sufficient grounds for the retention of the Lancidæ as a distinct family, with the following definitive characters:

1. The limpet-like shell and the reduction of the visceral mass, especially at the expense of the digestive glands.
2. The almost complete ring of columellar muscle.

3. The development of the mantle edge into a special organ for aeration, with the coincident enlargement of the heart and mantle veins.
4. The vestigial "lung" and its confluence with the hind-gut.
5. The distinctly posterior allocation of the common opening of the lung and hind-gut, which appears to be correlated with the distortion of the ganglionic ring in the same direction and with the hyperstrophic position of the apex of the shell.
6. The enormous size of the ovotestis and seminal reservoirs.
7. The asymmetrical, bicuspid central and the squarish reflections of the laterals in the radula.

DESCRIPTION OF FIGURES

All drawings are made with the aid of the camera lucida. The histological figures represent somewhat idealized optical sections; the cells are oriented so that the lumen of the gland or organ is towards the top of the plate.

PLATE 11

Scales represent lengths of five millimeters.

Fig. 1. Ventral view of retracted animal within outline of shell. Common opening of the lung and hind-gut (A) and positions of male and female sex openings indicated. Magnification the same as in fig. 2.

Fig. 2. Dorsal view of animal after removal of shell. Visceral dome, surrounded by columellar muscle-ring, represented as slightly more transparent than is actually the case. Broken lines give outlines of lung, ureter and end of hind-gut.

A....................common opening of lung and hind-gut.
H....................auricle of heart (dotted outline).
K....................kidney (dotted outline).
U....................opening of ureter into lung.

Fig. 3. Dorsal view of visceral mass inside of columellar muscle-ring (cut at anterior end), after removal of roofing membrane, pallial complex and most of free mantle. Lines of demarcation between anterior and posterior lobes of liver and between latter and ovotestis are accentuated. Broken lines show course of hind-gut through free mantle. Scale is upper one of the two.

A....................common opening of lung and hind-gut.
B....................bursal sac.
D....................seminal reservoirs of ovisperm duct.
H....................second free portion of vas deferens.
L....................anterior (smaller) lobe of liver.
M....................heaviest column of muscle-ring.
O....................oviducal bulb.
P....................second or true prostate.
T....................ovotestis (lighter than liver).

Fig. 4. Anterior portion of digestive system, removed and straightened out. Buccal mass, salivary glands (S), oesophagus, gizzard (bilobed), pylorus with ends of two hepatic ducts (L), and beginning of intestine. Magnification practically the same as in fig. 3.

Fig. 5. Left side of junction between pylorus (at left) and intestine (at right). Magnification about that of fig. 6.

D....................pyloric diverticulum.
L....................cut end of left hepatic duct.

Fig. 6. Kidney and pericardium, dissected loose and turned back sharply to right, so as to be viewed from ventral side. Ureter still remains in normal position, as viewed dorsally. Scale is placed under that of fig. 3.

X....................position of renopericardial orifice.

Fig. 7. Optical section across partition between ureter (above) and lung (below) to show columnar epithelium of former and squamous lining of latter. This is an enlargement of a small portion of fig. 10. Magnification as in fig. 12.

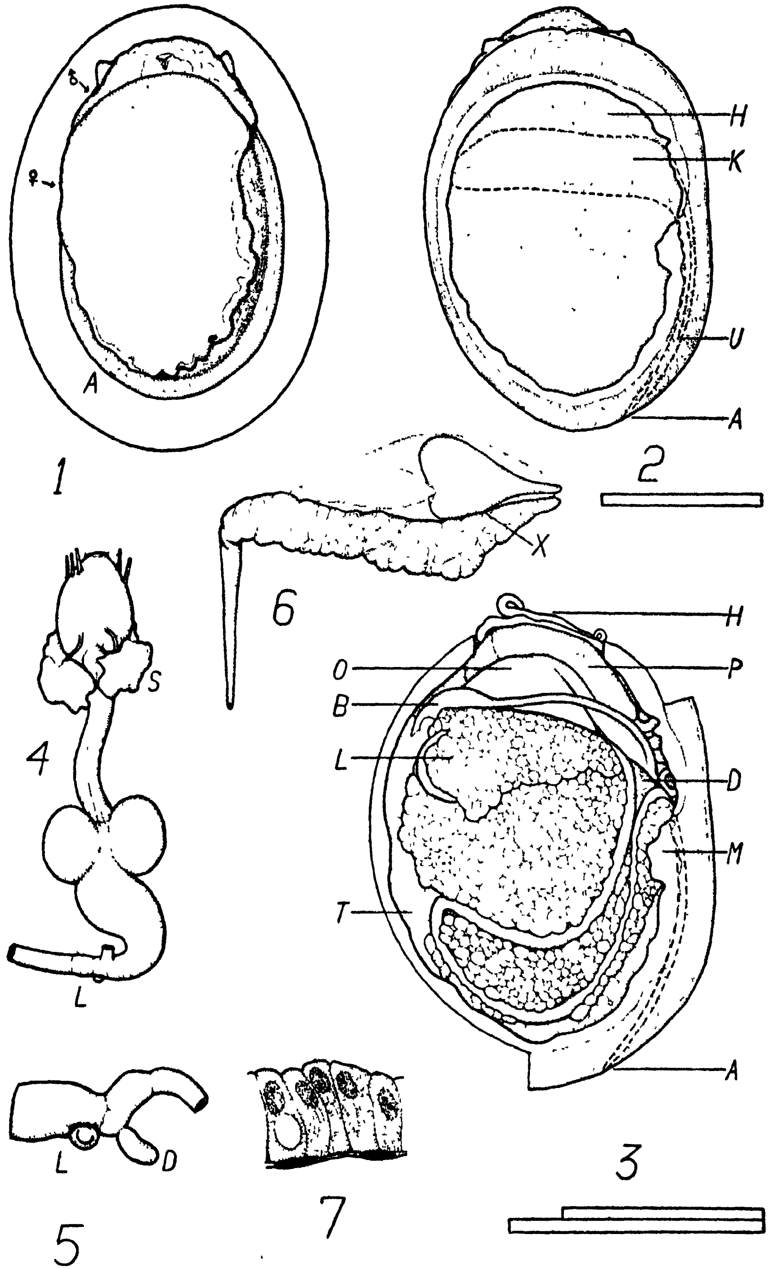
A
1
H
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PLATE 12

Scales of figs. 8 to 10 (under last) and 11 represent one millimeter; those of figs. 12 and 13 (under former) fifty microns. Figs. 8 to 11, although diagrammatic, are actual drawings of stained sections (animal retracted). The following letters are the same in all figures:

A....hind gut.	M....columellar muscle.
B....bursal sac.	O....oviduct.
F....foot (dense portion).	P....second prostate.
G....oesophagus.	S....blood sinuses.
H....ventricle of heart, pericardium.	T....ovotestis.
I.....imbedded portion of vas deferens.	U....Ureter.
K....kidney.	V....free vas deferens.
L....liver (in muscle gap).	Z...."lung" cavity.

Fig. 8. Transverse section through right free mantle at confluence of hind-gut and "lung."

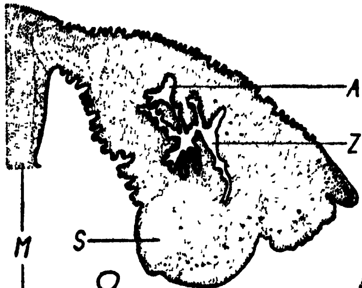
Fig. 9. Same at external ureteric opening.

Fig. 10. Same at muscle gap, near junction of ureter and kidney.

Fig. 11. Cross-section through entire animal. This section is not exactly transverse, but passes more anteriad at the left side, so that it cuts ventricle of heart (in pericardium) as well as anterior region of kidney and "lung." Besides the structures labeled, three more loops of free portions of vas deferens, as well as all four regions of oviduct, are included. Also, tip of radular pouch and of left horn of its cartilage appear below and to left of oesophagus (G). All organs have shrunk slightly, so hæmocœle appears extraordinarily spacious.

Fig. 12. Optical section through a fold of hind-gut; intestinal epithelium (above) with two goblet-cells.

Fig. 13. Optical section of three "liver cells" and two "lime cells" of hepatic alveolus.



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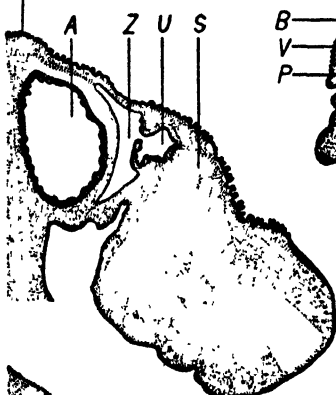

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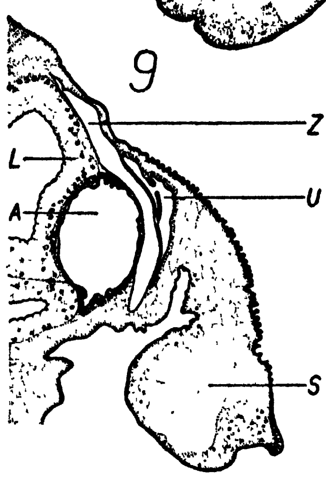

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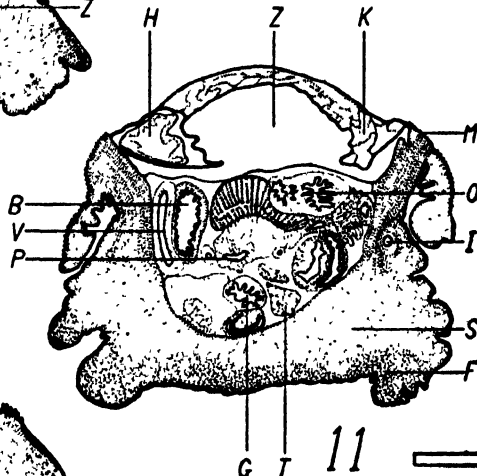

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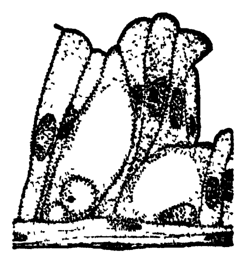

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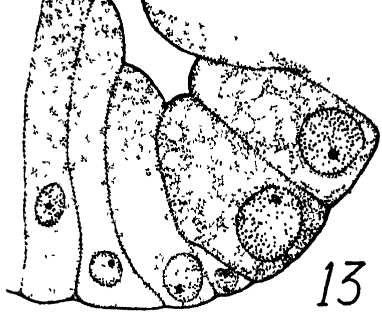

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Plate 13

Scale of fig. 14 represents length of five millimeters; that of fig. 16, two millimeters; those of 17 to 20, fifty microns.

Fig. 14. Genitalia with male and female sex openings in usual relations, but with organs straightened out and arranged so as to be seen at best advantage. Hyperphallar retractor cut so as to straighten out penis. Transverse sections cut with razor and viewed by surface illumination. Scale of sections can be judged by comparison with main figure.

A..........Transverse section through oviducal bulb.
B..........Through postbulbar (vaginal) portion of oviduct.
C..........Through first or false prostate.
D..........Through second or true prostate.
E..........Through larger sac of penis.

Fig. 15. Optical, sagittal section of hyperphallus, made from slightly flattened mount in Farrant's medium.

Fig. 16. Ganglionic ring in natural position, except for slight anteriad displacement of buccal ganglia; viewed from dorsal side. Nerves labeled:

A....aortic or anal (abdominal ganglion).
C....middle labial (cerebral ganglion).
D....superior pedal (pedal ganglion).
E....central pedal.
F....inferior pedal.
G....subintestinal or genital.
H....hyperphallar and penial.
I.....inferior cervical.
K....superior cervical.
L.....anterior frontolabial.
M....anterior pallial (visceral gang.).
N....nuchal.
O....optic.
P....posterior pallial.
R....radular (buccal ganglion).
S....salivary.
T....tentacular.
U....columellar.
X....subcerebral commissure.

Fig. 17. Transverse optical section of a cell from tubule of second prostate. Scale is upper one in lower left corner of plate.

Fig. 18. Three cells from epithelium of bursal sac. Magnification as in fig. 12.

Fig. 19. Two cells from epithelial lining of first prostate. Magnification as in fig. 12.

Fig. 20. Rogue River specimen; epithelial lining and outer layer (below) of prebulbar region of oviduct. Scale is lower one of the two.

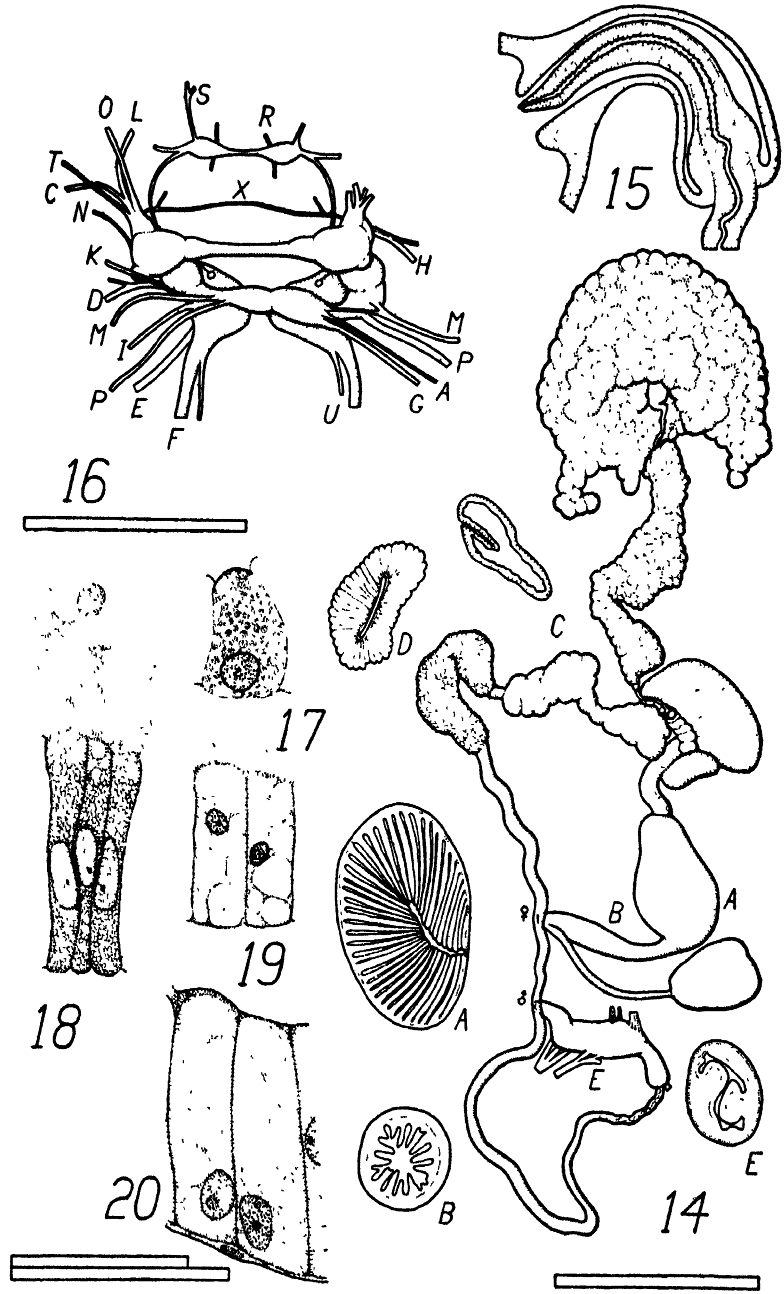
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PLATE 14

Scale of fig. 22 represents length of one millimeter; those of 24 and 26, one-half millimeter; those of 23 and 25, fifty microns.

Fig. 21. Three cells from epithelium of albumen gland. Magnification as in fig. ii-12.

Fig. 22. Rogue River specimen; cross-section a short distance behind anterior end of buccal mass. The section is not quite transverse, so that the radular cartilage is cut farther anteriad on the right side.

B....................lower portion of buccal cavity.
C....................radular cartilage.
G....................oesophagus.
M....................posterior end of mouth.
P....................pharyngeal cavity.
R....................functional, anterior portion of radula.
U....................posterior, folded portion of radula.
W....................muscular walls of buccal mass.

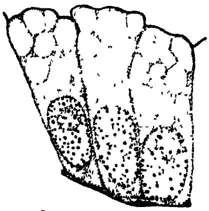
Fig. 23. Central and 1st lateral of radula slightly separated but otherwise in usual relations to each other; also 7th and 14th teeth (1st and 8th marginals). The hair-line represents the shape of the right half of a transverse row with positions of central, 7th and 14th teeth and edge of radula marked.

Fig. 24. Median jaw with approximate outline of right accessory thickening.

Fig. 25. *Lanx (Fisherola) lancides;* radula from dried specimen, collected in Snake River at Lewiston, Idaho, by H. Hemphill (A. N. S. P. 113838). Central and 1st lateral in usual relations; also 9th and 17th teeth (1st and 9th marginals). On account of the larger number of teeth in this species, these examples are directly comparable to those figured for *L. alta.* The hair-line represents shape of right half of transverse row with positions of central, 7th, 14th, 21st and 28th teeth and edge of radula marked.

Fig. 26. *Lanx (Fisherola) lancides;* median jaw of specimen in fig. 25.

Fig. 27. Rogue River specimen; detail of radular cartilage. Magnification as in fig. 12. Pigment granules near nuclei are very characteristic.



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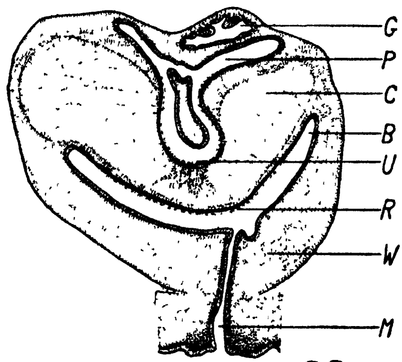

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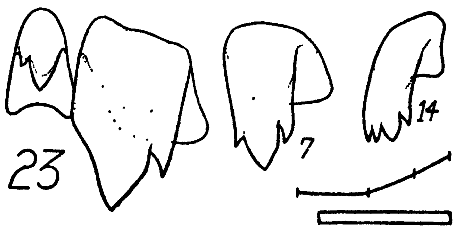

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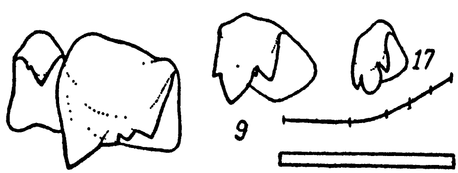

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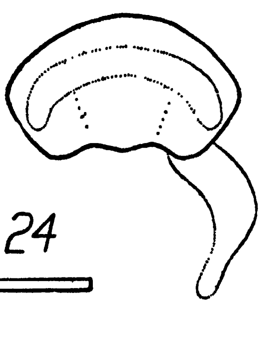

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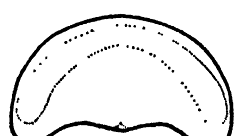

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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XIV, No. 9, pp. 171-173 AUGUST 14, 1925

IX[1]

EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GULF OF CALIFORNIA IN 1921

THE PHALANGIDA

BY

RALPH V. CHAMBERLIN

Harvard University

Although I am assured by Joseph C. Chamberlin, who had special charge of the collecting of the Arachnida, that special efforts were made to find phalangids during the Expedition of the California Academy of Sciences in 1921, none whatever was found on the islands of the Gulf of California. Specimens were secured, however, at three points on the adjacent mainland, namely, at Puerto Escondido, Lower California, at Nogales, Arizona, and at Guaymas, Sonora. The specimens secured represent the two new species described below.

PHALANGIIDÆ

1. **Liobunum escondidum** Chamberlin, new species

Male: Dark reddish brown above; a lighter band beginning anteriorly at the stink-pore on each side and extending caudad and uniting with the band of other side across posterior portion of abdomen, but the light areas usually obscure posteriorly. Eye-tubercle light mesally, dark along

[1]No. 33 of the Gulf Expedition papers.

ridges. Venter light brown. Coxæ of legs without marks; trochanters ordinarily dusky or blackish at sides. Legs reddish brown, paler distally; the patellæ and the tibiæ at distal ends blackish; the femora also often darker at proximal end. Cheliceræ yellow throughout. Palpi light brown, more yellowish distally.

Abdomen appearing blunt from above, the last segments being bent down. Dorsum evenly granular throughout. Ventral surface of abdomen wholly smooth.

Eye-tubercle smooth excepting for a few scattered spinous points on the ridges.

Legs long. Coxæ finely granular; each with a series of crowded, narrow tubercles or teeth both on anterior and on posterior margin, the seriate tubercles from simple to trifid.

Femur of palpus about equal in length to the tarsus and to the tibia + patella; strongly armed with spinous points beneath. Patella bearing spinous points on all sides; without an inner apophysis. Tibia with spinous points which are more numerous beneath. Tarsus without spinous points.

Length, 6.25 mm.; femur I, 11 mm.; femur II, 17 mm.; femur III, 11 mm.; femur IV, 15 mm.

Type: Male, No. 1642, Mus. Calif. Acad. Sci., and *paratypes* in Mus. Calif. Acad. Sci. and M.C.Z., **Puerto Escondido, Lower Calif.,** taken June 14, 1921, by Joseph C. Chamberlin. In all, four males were taken "along creek bed near fresh water" at an elevation of 1600 ft.

2. **Trachyrhinus sonoranus** Chamberlin, new species

Male: Body above yellowish along the sides, the middle region brownish, the color deepest in spots adjacent to the yellow on each side; brown mottlings also on the sides; eye-tubercle on base of a dark brown or blackish delta-shaped outline the anteriorly directed apex of which is open or broken. Ventral surface in general clear yellow, but the coxæ of the legs spotted with brown at the sides and especially distally. Palpus yellow excepting for a dark spot at distal end of femur and dark markings on patella and tibia. Cheliceræ clear yellow. Legs in general brown, the patellæ sometimes nearly black, the legs lighter, yellowish distally, the femora and tibiæ often light at distal ends.

The body is flat and hard. Two sharply defined transverse sulci behind the eye-tubercle separating off the abdomen. Surface of abdomen hard, densely covered with contiguous pits or cup-like depressions; posterior segments bent down ventrad so that the abdomen in dorsal view appears almost truncate. Ventral surface more finely roughened than the dorsum. Coxæ densely granular and tubercular, the tubercles over distal portion in

particular conical, but none of these in definite marginal series. Coxa II much narrower than I and III below which it extends like a wedge. Coxæ in order of thickness, II, I, III, IV.

Eye-tubercle armed behind and in front, as well as above, with stout, conical spines which form two irregular rows, one adjacent to each eye, thus leaving a median longitudinal space free from them.

Mandibles small, of ordinary form.

Palpus slender; the femur about equal in length to tibia + patella. Trochanter and femur with numerous spinous points below; patella with similar points especially laterally and above and on its inner side bearing a short and rounded but distinct apophysis; tibia a little more than twice as long as thick, densely clothed on all sides with spinous points; tarsus with a few spinous points beneath.

Legs long. Trochanters strongly tuberculate. Other joints with longitudinal rows of teeth which are weaker and finer on patellæ, and tibiæ. Tibia II with six false joints.

Length, 7 mm.; femur I, 7 mm.; femur II, 13 mm.; femur III, 8 mm.; femur IV, 9.5 mm. Length of leg IV, 39 mm.; of leg III, 29 mm.; of leg II, 51 mm.; of leg I, 28 mm.

Type: Male, No. 1643, Mus. Calif. Acad. Sci., **Guaymas, Sonora,** April 15, 1921, J. C. Chamberlin, "taken under a stone in a patch of dry grass on ledge of cliff near summit (400 ft.)". *Paratypes* in Mus. Calif. Acad. Sci. and M.C.Z., one taken at Guaymas with holotype and six specimens taken by E. P. Van Duzee at Nogales, Arizona, Apr. 4, 1921.

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X

SCELLUS VIRAGO ALDRICH (A TWO-WINGED FLY) AND TWO FORMS CLOSELY RELATED TO IT

BY

M. C. VAN DUZEE

Buffalo, N. Y.

In the two tables of species of the North American Scellus published since 1907 the first couplet reads about as follows:

Third joint of antenna very long and pointed.....*virago* Aldrich
Third antennal joint very short.............................. 2

Below two more species are described with antennæ formed the same as in *virago,* and which would pass for that species if no typical specimen of *virago* were at hand to compare them with.

In 1915 I took a series of Scellus at Great Salt Lake, Utah, which I determined as *virago,* and had no doubt of the determination until 1923 when my brother sent me two specimens taken in California, which I found very distinct from those taken in Utah. In January, 1924, while at the National Museum I looked up the type of *virago* and found both my forms quite distinct from that species. I am redescribing *virago* to cover the points in which the three forms differ and giving full descriptions of the new forms. These three species differ from all our other species in having the third antennal joint very long and pointed. They have very long anal appendages issuing from between the fourth and fifth abdominal

segments; these I am calling the outer appendages, although I doubt whether they are morphologically the same as the outer lamellæ of other Dolichopodidæ. Below these are two or three pairs of appendages which I am calling the inner appendages.

I am greatly indebted to Dr. J. M. Aldrich for the loan of one of the type specimens of *virago* from which to make the drawings for this paper.

Table of the males of the *virago* group:

1. Middle tibia with long curled hair only near the tip (fig. 7) .... *virago* Aldrich
   Middle tibia with long curled hair on nearly their whole length (figs. 15 & 23) 2
2. Long anal appendages arising between fourth and fifth abdominal segments nearly bare, except at tip (fig. 18).... .... *varipennis*, new species
   Long anal appendages with long curled hair on apical two thirds of one edge (fig. 8) .... *crinipes*, new species

Scellus virago Aldrich

Aldrich, Entomological News, Vol. xviii, p. 133, 1907; Greene, No. 2529, Procs. U. S. Nat. Mus., Vol. 65, Art. 16, p. 3, original description copied, figs. 8, 15, 19 and 28, 1924.

Male: Antennæ much elongated, the joints being 8-3-25 twenty-fifths of a millimeter long. Four black bristles and several long white hairs above each anterior coxa; fore coxæ with a few small pale hairs on anterior surface and several black bristles, extending upward from the tip; middle trochanters with several small black hairs, hind ones with black bristles; fore femora with numerous bristles below, some of those near the base being about as long as the thickness of the femora; middle femora slender, somewhat arched, nearly bare below, but with a few bristles on apical third of anterior surface, two bristles above and one or two on posterior surface, also a row of short, delicate hairs on the lower surface; posterior femora with two rows of hairs below, which are a little longer than those on the sides, the hind femora a little more thickened than the middle ones, but not as much so as the anterior pair; fore tibiæ (figs. 5, 6) with hairs below on basal half and stout bristles on apical half, these hairs not as long as the diameter of the tibia at base, and the bristles scarcely as long as the thickness at point of insertion; on anterior surface, before apical fourth a moderately large, stout, curved spine, shining black when viewed from below, but green and dull when seen from above; the large projection below at tip shining black, with a pair of little bristles at tip, several stout, very short, erect spines near the tip on apical margin where there is also a number of long hairs or

bristles extending upward towards the tarsus; on the inner margin a row of short hairs, the upper portion of the end of the tibia rounded and fringed with short, close-set, yellow hairs; middle tibiæ (fig. 7) on the lower surface of basal three-fourths with only straight or slighly bent hair, on apical fourth a cluster of curled hairs, twice as long as diameter of thickened end of tibia; below with two subapical bristles; anterior surface with seven long bristles, nearly as long as second joint of middle tarsi; beyond these a pair of bristles a little shorter, one nearly above the other, and at apical eighth another short bristle; on upper surface near basal fourth one pair of bristles and a single one at middle on posterior edge; posterior tibiæ without bristles, but with a stripe of very short yellow hair on upper posterior edge of apical fourth, widest apically; these tibiæ bent outward a little at tip when viewed from above; all tibiæ with more or less of apical portion of a beautiful blue; middle basitarsus (fig. 7) with several bristles, the two nearest base 2/5 of a millimeter long; posterior basitarsus with two bristles above, one near the base and one at basal third; also a smaller bristle at apical third.

The anal appendage which issues from between the fourth and fifth segments (fig. 1) is about 2.4 millimeters long, the apical portion spoon-shaped, the narrow part whitish, black at base and fringed on one edge, except at base, with pale hairs; the apical portion, or spoon (fig. 2) has these pale hairs continued to tip, this fringed edge narrowly black and with a stripe of curled hair on the inner edge of the black border; apical margin to lower angle of tip very narrowly black; lower angle with a cluster of spreading, whitish bristles; two pairs of inner appendages visible, first pair (fig. 3) large, black and fringed with small hairs above; second pair (fig. 4) smaller and black, tipped with two small stiff little hairs.

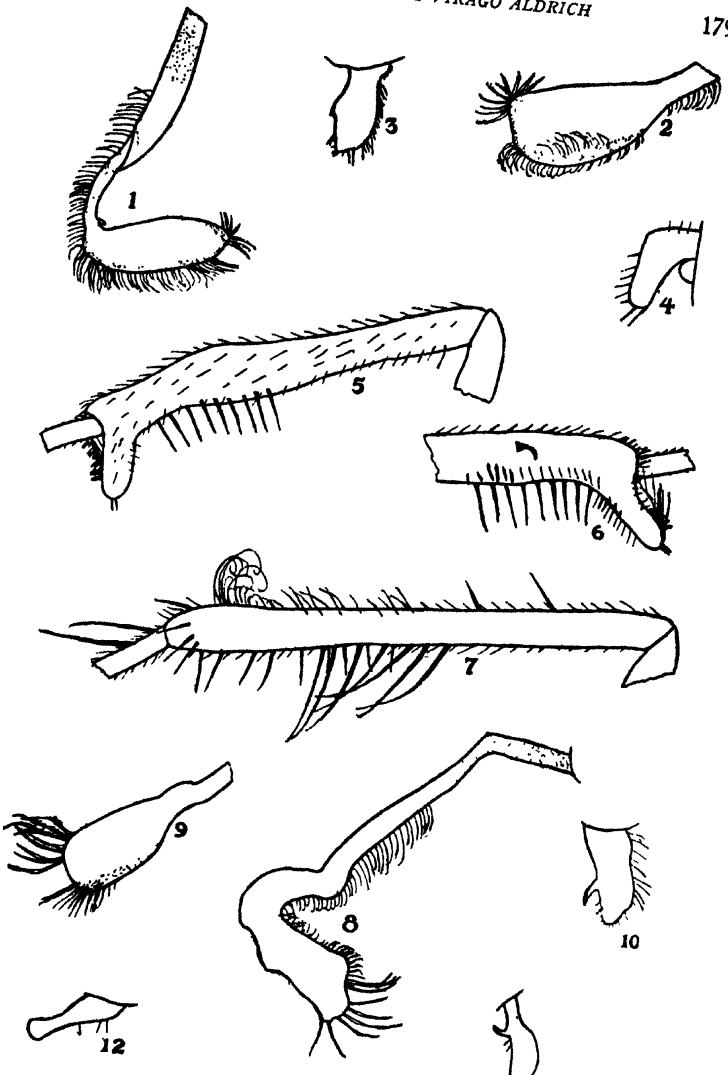
Scellus crinipes M. C. Van Duzee, new species

Male: Length, exclusive of anal appendages, 5 mm.; of wing 7 mm. Face long, quite wide, covered with white pollen (not silvery) reaching the lower corner of eye; portion below suture longer than wide; lower edge rounded; palpi and proboscis black, the former with white pollen; antennæ elongated, black; first two joints taken together about equal to lower portion of face, third joint equal to length of upper part of face; joints of antennæ 8-3-28 twenty-fifths of a millimeter long; arista nearly apical, 8/25 of a millimeter long; front black, with brown pollen in central portion, that above antennæ and on a narrow space along orbits, whitish; upper orbital cilia formed of five black bristles on each side; one pair of postverticals, and quite an abundant beard of long whitish hair.

Dorsum of thorax opaque with a grayish brown pollen, which leaves a narrow coppery line each side of acrostichal bristles, and a large space of same color before scutellum; a broad, poorly defined, shining stripe

on the sides of the dorsum when viewed from behind; bristles of thorax inserted in dark brown dots; pleuræ more black, with white pollen; scutellum with one pair of bristles; propleura with three black bristles and a few pale hairs above fore coxa; abdomen short, bronze-colored, with green and coppery reflections, dulled with white pollen; each visible segment with three shining black dots on lower part of sides; hairs on the abdomen small, pale; hypopygium mostly concealed. There are anal appendages projecting from between fourth and fifth segments on sides of dorsum (fig. 8), long and narrow with a large spoon-shaped end, black at base but otherwise mostly white; upper margin of spoon (fig. 9) narrowly blackish, outer angles each with a small black spot; on one edge of narrow portion and extending onto the spoon is a fringe of quite long pale hairs; at each outer angle of the spoon is a somewhat fan-shaped cluster of hairs, which appear brown in certain lights; three pair of inner appendages; the first (fig. 10) black, with a thorn-like projection on side and fringed with small hairs; second (fig. 11) yellowish with a curved thorn on side and with end enlarged; third pair (fig. 12) yellow, halter-like.

All coxæ black with white pollen; anterior surface of fore coxæ with a few pale hairs and with a row of five, rather small, black bristles on outer edge of apical half; middle and hind coxæ with a few stiff black hairs at tip; all femora and tibiæ green; fore tibiæ on most of apical two-fifths black with some coppery reflections; all tarsi black, sometimes more or less greenish; fore femora thickened, with numerous spines below, those near the base nearly as long as thickness of femora at point of insertion, those near tip short; anterior tibia (figures 13, 14) thickened and bent; on anterior surface a little beyond middle a large, slightly bent thorn; about opposite this thorn on lower edge begins a row of large, black, stubby bristles; when viewed from tip along inner surface these bristles bend inward and there are several bristles around the thorn that bend towards those in lower row; at tip is a large lobe extending downward, which has a row of small hairs on edge nearest femora, two small bristle-like hairs at tip, and delicate hairs on apical edge, where there are also a few stubby spines near tip; on upper portion of end of tibia are some small yellow hairs; middle femora long, not thickened, arched, with a few short bristles, six on upper and four or five on lower anterior edge, none as long as diameter of femora; middle tibiæ (figs. 15, 16) with long, black, curled hair on nearly their whole lower surface, these hairs a little longer near tip; on upper posterior edge of middle half, is a row of eight bristles scarcely as long as diameter of tibia at their insertion; commencing on upper anterior edge a little beyond the middle is a row of long, deep black bristles, this row slants downward and becomes a dense cluster just beyond apical third; they are as long as the thickened end of tibia; two moderately long bristles below and two above near apical end of tibia; posterior femora and tibia long and rather slender, the former only a little thicker than middle femora, and with a few short bristles, the latter without bristles; all tarsi plain; first joint of fore tarsi with rather



Explanation of Figures

Fig. 1, *virago* Aldrich, anal appendage. Fig. 2, *virago*, tip of anal appendage seen from the rear. Fig. 3, *virago*, first inner appendage of the hypopygium. Fig. 4, *virago*, second inner appendage. Fig. 5, *virago*, fore tibia, posterior view. Fig. 6, *virago*, tip of fore tibia, anterior view. Fig. 7, *virago*, middle tibia and base of tarsi. Fig. 8, *crinipes*, new species, anal appendage. Fig. 9, *crinipes*, tip of anal appendage seen from above. Fig. 10, *crinipes*, first inner appendage of the hypopygium. Fig. 11, *crinipes*, second inner appendage. Fig. 12, *crinipes*, third inner appendage.

long, dense, delicate hairs below; posterior basitarsus with several small bristles on upper surface, two being slightly longer than diameter of joint. Following are lengths of tibiæ and tarsal joints in twenty-fifths of a millimeter: fore tibia, 44; joints of fore tarsi, 42-29-19-11-8; middle tibia, 84; joints of middle tarsi, 49-24-14-9-8; posterior tibia, 78; joints of posterior tarsi, 57-35-19-12-8. Calypters whitish with a brown tip and short white cilia. Halteres yellow.

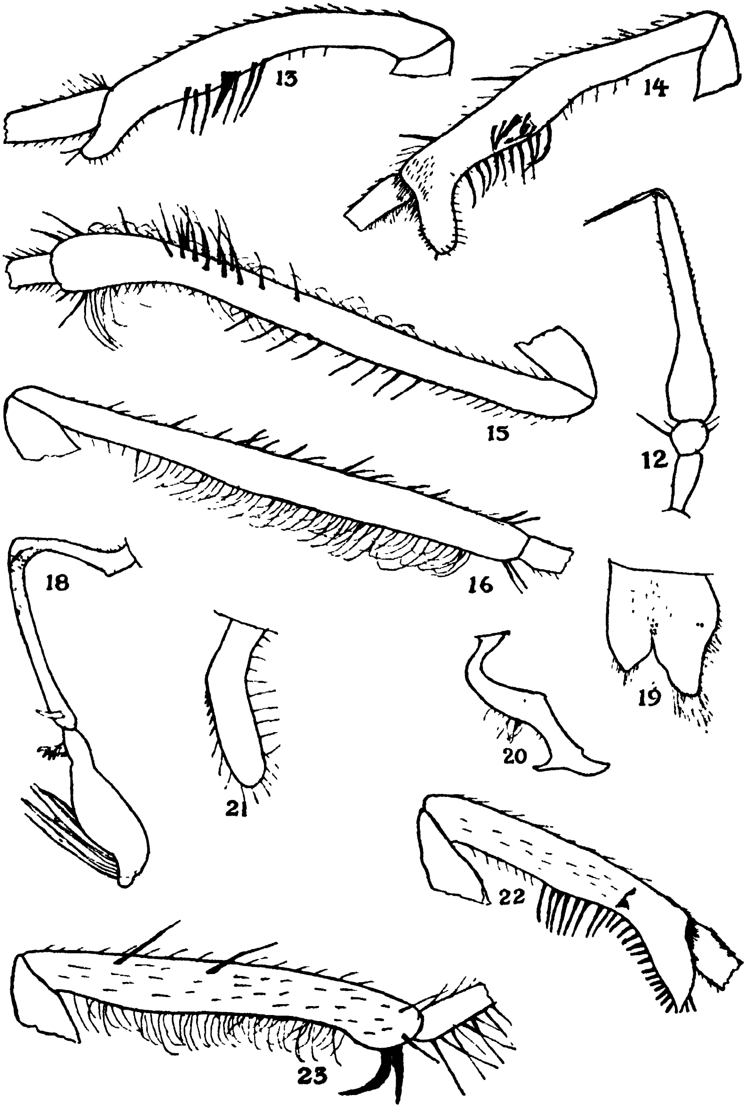
Wings grayish on posterior half, tinged with brown from the costa to back of third vein, in basal half of discal cell, extending back of fifth vein and along fourth vein; a distinct brown spot on bend of last section of fourth vein, and a double spot on the cross-vein; costa as far as tip of first vein yellowish, other veins brown, except at extreme base; tips of third and fourth veins close together; sixth vein reaching about half-way to wing margin; cross vein 20, last section of fifth vein 12 twenty-fifths of a millimeter long, the latter at nearly right-angles to wing margin; the former oblique, but not parallel with the wing margin.

Female: Length 4.5-6 mm.; of wing 6-7.2 mm. Color of all parts about same as in male; face a little wider; joints of antennæ 8-4-18 twenty-fifths of a millimeter, arista 15/25; fore femora with spines below as in male; anterior tibia thickened, with a small projection below at tip, which has a fringe of stiff hairs on the edge nearest the femora; these tibiæ with several bristles on upper surface and two rows below, two or three of the bristles in the lower anterior row being as long as thickness of tibia; middle femora and tibiæ nearly straight and plain with a few short scattering bristles. Following is length of tibiæ and tarsal joints in twenty-fifths of a millimeter: fore tibia, 47; joints of fore tarsi, 35-25-17-11-7; middle tibia, 86; joints of middle tarsi, 48-23-15-9-8; posterior tibia, 101; joints of hind tarsi, 51-32-20-11-8. Wings about as in the male.

Described from five males and eight females; one pair taken at mouth of Bear River, Utah, July 2, 1916, by Dr. Alexander Wetmore; the others taken by me in the grass on the shore at Saltair, Great Salt Lake, Utah, June 8, 1915. The type and allotype are from among the latter specimens and are in the author's collection. Paratypes in the California Academy of Sciences and the U. S. National Museum.

Scellus varipennis Van Duzee, new species

Male: Length, without the anal appendages, 7 mm.; with appendages, 9.5 mm.; length of wing, 8 mm. Face wide; palpi and face covered with yellowish gray pollen; front opaque with brown pollen, except a narrow line of pale pollen along the orbits; antennæ (fig. 17), black; length of its joints in twenty-fifths of a millimeter are 10-4-28, and of arista, 8; arista inserted close to the tip; upper part of the posterior orbits with six large black bristles; one pair of postverticals; beard abundant, long, white.



EXPLANATION OF FIGURES

Fig. 13, *crinipes,* fore tibia, seen from above. Fig. 14, *crinipes,* fore tibia, anterior view. Fig. 15, *crinipes,* middle tibia, upper anterior view. Fig. 16, *crinipes,* middle tibia, posterior view. Fig. 17, *varipennis,* new species, antenna of male. Fig. 18, *varipennis,* anal appendage. Fig. 19, *varipennis,* first inner appendage of the hypopygium. Fig. 20, *varipennis,* second inner appendage. Fig. 21, *varipennis,* third inner appendage. Fig 22, *varipennis,* fore tibia, anterior view. Fig. 23, *varipennis,* middle tibia and base of tarsi.

Dorsum of thorax coppery, so thickly covered with grayish brown pollen as almost to conceal the ground color, except on the posterior flattened space before the scutellum, with a narrow dark line each side of the small acrostichal bristles; dorsocentrals small, except posterior two; prothorax with three large black bristles and several pale hairs above fore coxa; scutellum more green than thorax and with one pair of marginal bristles; dorsum of abdomen coppery, covered with white pollen on sides; each segment with three black dots on lower edge of sides; abdomen with six visible segments on dorsal line; the long anal appendages issue from between fourth and fifth segments, on sides of the dorsum (fig. 18), bend near the base and from that point extend almost directly backward, base black, middle portion white and most of the spoon-shaped end brown; before base of spoon a yellowish horn and beyond this a pale appendage, which seems to be formed of flattened bristles fused together at their base; a large, more or less fan-shaped tuft of pale bristles at tip of spoon; upper portion of hypopygium concealed within seventh segment of abdomen, upper part of posterior surface with a number of pale bristles extending backward; three pair of inner appendages, the first (fig. 19) black, wide, with two points, each tipped with a tuft of yellow hairs; the fringe of hairs on upper edge more grayish; second pair (fig. 20) yellow, quite slender and bent, with a few short hairs near middle; third pair (fig. 21) black, elongate, rounded at tip, fringed with pale hairs, widely separated, being placed on each side near the venter of fifth segment.

Coxæ black or slightly coppery; anterior pair covered with dark gray pollen on front surface, which has a few pale hairs and also a row of very short black bristles on apical half; middle coxæ with black bristle-like hairs at tip; all trochanters with several small spines or bristles; all femora coppery, dulled with gray pollen, sometimes with green reflections at base; anterior pair much thickened at base, tapering to their tips, with many stout bristles below, those at base long, the ones near tip very short; fore tibiæ (fig. 22) 52 twenty-fifths of a millimeter long, stout, with a large projection below at tip, metallic green, dulled with gray pollen, tip black, this color extending as a stripe on posterior surface nearly to middle, with a row of about six short, stout bristles extending basad from the end of black stripe, but not reaching base; on lower anterior surface with a row of larger bristles, which are as long as thickness of tibia, and extend along lower edge of projection at tip of tibia to its apex, those on the projection shorter and spine-like; above tip of projection two of these spines and a fringe of yellow hairs at tip of tibia. The thorn usually found on anterior surface of tibia in this genus is represented by a small, shining black, elevation on the surface near apical third, this with the appearance of a black transverse line with two slight elevations, the upper of which is only slightly raised above the surface; middle femora long, bent, a little thickened in the middle, without any long bristles, their hair black, except a row of short, very delicate pale ones on lower posterior surface; middle tibia (fig. 23) green, dulled with gray pollen, with coppery reflections on upper surface, except at tip; lower posterior sur-

face dark, shining green; tibiæ a little thickened and bent downward just before tip; below close to tip a pair of long curved thorns and a pair of shorter bristles above near tip; two long bristles on upper posterior surface of basal half; on anterior surface is one long bristle near base above and a row of three long ones beginning at middle; beyond these two smaller ones, one below the other. The whole lower surface of these tibiæ is covered with long, black, curled hair; many of these hairs longer than thickness of tibia; they are mostly of nearly equal length from base to near tip, where they end abruptly, leaving tip of tibia bare; viewed from above there is a dense bunch of very black, long, curled hair near tip on posterior surface, these connected with those on lower surface; posterior femora distinctly thickened, with three rather small bristles on upper surface of apical third; near lower edge of anterior surface of basal half is a row of black bristles, also another row of bristles on lower edge of anterior surface of apical half; posterior tibia 102 twenty-fifths of a millimeter long and bent near apical third when seen from above; lower surface hollowed out before tip, which projects a little downward at apex; lower surface of apical third with a row of small black spines which end before tip; on upper posterior surface a stripe of dense, very short, yellow hairs, which reach from tip nearly to middle; first joint of anterior tarsi with a dense fringe of short golden yellow hairs on whole of lower anterior surface, and a fringe of longer black hairs on lower posterior surface, first joint of middle tarsi (fig. 23) with several long bristles at base below, fully as long as curved thorns at tip of tibia; also several shorter bristles beyond these; hind tarsi with two or three bristles above, which are as long as diameter of joint; length of joints of tarsi given below in twenty-fifths of a millimeter; joints of fore tarsi, 37-28-20-14-11; of middle ones, 56-25-18-11-10; joints of hind tarsi, 58-41-26-15-11. Calypters and halteres yellow, the former with white cilia.

Wings tinged with brown, posterior margin and center of cells more gray; a conspicuous whitish spot back of fifth vein near root of wing; they have a dark brown spot on the bend of last section of fourth vein and a double spot on the cross-vein; sixth vein faint, not reaching wing margin; last section of fifth vein 12, of cross-vein 23, twenty-fifths of a millimeter long. Described from two males.

Type: Male, No. 1647, Mus. Calif. Acad. Sci., collected by C. L. Fox, August 2, 1922, at **Lake City, Modoc Co., California.** *Paratype,* male, same data.

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XI

BEES IN THE COLLECTION OF CALIFORNIA ACADEMY OF SCIENCES

BY

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1. Colletes myroni Cockerell

Female: San Francisco, California, April 30, 1911 (J. A. Kusche). This is a surprising record, as the species was described from Colorado. The head and pleura have black hair, while that on the thorax above is bright ferruginous.

2. Colletes slevini Cockerell, new species

Female: Length about 11 mm., anterior wing 7 mm.; black, the head and thorax densely covered with clear tawny yellow hair, becoming whitish on cheeks and thorax beneath, on dorsum of thorax rather short but not moss-like, and without black hairs intermixed; head broad, orbits converging below; malar space much broader than long; mandibles black; clypeus densely and coarsely striate-punctate, glistening; antennæ entirely black, flagellum short; mesothorax smooth and shining on disc posteriorly; base of metathorax transversely channelled, with plicæ at sides; tegulæ very dark brown; wings hyaline, appearing milky; stigma small, dark brown; nervures black, second cubital cell very broad, receiving recurrent nervure in middle; legs with pale hair; abdomen with the first segment opaque except posteriorly, the punctures fine and weak; following segments more shining, all with apical yellow hair bands pale and not very dense; first segment with much yellowish hair at base, and

long hairs overlapping the middle part. Basal nervure falling considerably short of nervulus.

Easily known from such species as *C. americana* Cresson by the dull, not polished, first abdominal segment. In this it rather resembles *C. andrewsi* Ckll., but differs from it by being considerably smaller and less robust, with very much shorter wings.

Type: Female, No. 1648, Mus. Calif. Acad. Sci., collected by L. S. Slevin, September 24, 1922, at **Paraiso Springs, Monterey County, California.**

3. **Colletes daleæ** Cockerell

Three females, La Paz, June 29 (Ferris).

4. **Hylæus conspicuus** (Metz)

Males: Santa Clara County, California, July 1, 1916 (W. M. Giffard). Compared with cotypes received from Metz. Mokelumne Hill, California, September (Blaisdell).

5. **Hylæus asininus** (Cockerell & Casad)

Males: Potholes, Imperial County, California, April 10, 1923 (Van Duzee).

6. **Hylæus giffardiellus** Cockerell, new species

Male: Length about 6.5 mm.; black, with the face markings deep chrome yellow and the wings fuliginous; orbits little converging below, face broad, entirely deep yellow (orange) below level of antennæ; supraclypeal mark much longer than broad, not notched above; lateral marks cut off mesad at about middle of supraclypeal mark, but extending as bands up orbital margins, ending abruptly but not dilated (style of *H. citrinifrons* Ckll.); labrum with a yellow spot and mandibles largely yellow; scape a little dilated, with a yellow stripe in front; flagellum bright ferruginous beneath; front and mesothorax (except posteriorly) dull, with very dense fine punctures; scutellum shining, the strong punctures distinctly separated; posterior face of metathorax dull, with a narrow shining median groove; prothorax above (except middle) and tubercles broadly yellow; tegulæ with a yellow spot; anterior tibiæ in front, middle

tibiæ broadly at base and a mark at apex, and basal half of hind tibiæ, yellow; basitarsi pale yellow, more or less dark at apex; first recurrent nervure reaching apical corner of first cubital cell; abdomen strongly and distinctly punctured; first segment with a small fringe of white hair at sides; second and third segments swollen in middle so that their apices appear depressed; hind margin of fourth and fifth segments faintly reddish.

Allied to *H. citrinifrons* (*Prosopis citrinifrons* Ckll.), but easily separated by the color of the antennæ, the longer supraclypeal marks, and strongly punctured abdomen. The face is much broader than in *H. stevensi* Crawford.

Type: Male, No. 1649, Mus. Calif. Acad. Sci., collected by W. M. Giffard, May 24, 1917, in **San Joaquin Co., California.** *Paratype,* one male, same data.

7. **Parandrena concinnula** Cockerell

Males from Whittier, Calif., Feb. 22, 1911, on flowers of Rhus (P. H. Timberlake). This is the first exact locality for the species.

8. **Diandrena perchalybea** (Viereck)

Females: Carmel, California, May 19 (Van Dyke). The hair of the head and thorax above is conspicuously paler than in a specimen from Washington State, whence the species was described, but the difference cannot indicate another species. The bees, like the birds and mammals, tend to melanism northward in the Pacific coast region, but good series from many localities will be required before we can fully elucidate the phenomenon and clearly distinguish whatever local races may exist. This work should of course be done by a resident of one of the coast States.

A male from Mokelumne Hill, California (Blaisdell), is referred here, though the male of *D. perchalybea* has not been described, and the reference should be confirmed by field observations. It is exceedingly like the males of *D. nothocalaidis* Ckll. and *D. cyanosoma* Ckll., the abdomen being duller than in the former, but more shining than in the latter. In all three

the face has long white hair, black along the orbits. In *D. cyanosoma* the area of metathorax is finely wrinkled or subreticulate all over, with short transverse rugæ on each side of middle line; in *D. nothocalaidis* it is quite different, with fewer rugæ, and well separated longitudinal ones in the basal part. In the male supposed to belong to *D. perchalybea*, it is sculptured practically as in *D. nothocalaidis*, but the posterior angle of the enclosure is much wider. The flagellum is much redder than in *D. nothocalaidis*.

The metathoracic sculpture of the male differs appreciably from that of the female *D. perchalybea*, but the difference is similar to that in the undoubted sexes of *D. nothocalaidis*.

9. **Nomia melanderi** Cockerell

Four males from Payette, Idaho, June 29, 1922 (Van Dyke), and one from Los Baños, California, May 22, 1918 (Van Duzee), have black tegulæ, and no green band on first abdominal segment, and must be referred to *N. melanderi*. The abdominal bands are bluish green, and the antennæ and structure of abdomen, etc., are as in *N. acus* Cockerell, which is apparently to be called *N. melanderi acus*, being merely a slightly modified southern race.

10. **Nomia californica** Cockerell

Preston, Idaho, 19 females, July 17, 1922 (Van Duzee); Logan, Utah, 4 females, July 18, 1922 (Van Duzee); Potholes, Imperial Co., California, 1 female, April 11, 1923 (Van Duzee). The Californian specimen has narrower bands than the others. The Utah and Idaho records represent a great extension of range, but I cannot find any grounds for separating them from *N. californica*.

11. **Halictus pavonotus** Cockerell, new species

Female (type): Length 8 to 9 mm.; head, thorax and abdomen green, legs and antennæ black; hair of head and thorax abundant, rather long, erect, fringed with ochreous, but practically white on cheeks and lower part of thorax; face broad, inner orbits curved, but eyes not distinctly

emarginate; clypeus prominent and produced, shining black, its upper part green, the surface longitudinally grooved; mandibles slender, black, rufescent at tip; supraclypeal area brassy; sides of face and front shining, but middle of front dull; mesothorax peacock green (purple in specimen from Golden Gate Park), dullish because very densely and finely punctured; scutellum shining, well punctured, depressed in middle; area of metathorax broad, well-defined, obtusely pointed behind, entirely covered with fine rugæ, which at sides form delicate ribs; sides of metathorax minutely roughened and dull; tegulæ punctured, piceous with hyaline margins, posteriorly with a red spot; wings hyaline, slightly brownish, stigma dull amber, nervures dilute fuscous; second cubital cell very broad, receiving recurrent nervure considerably before its end; third cubital subquadrate, narrowed about a third above; basal nervure falling short of nervulus; legs with abundant dull white hair, stained with red on outer side of middle tibiæ, a pale reddish tuft at end of hind basitarsi; hind spur curved, simple (wholly without spines); abdomen blue-green, shining, first segment highly polished; bases of second and following segments broadly covered with dull white tomentum, the apical portions also with appressed white hairs, evident only in certain lights, the apical half of the abdomen becoming very hairy; basal part of second ventral segment black and very finely cross-striate.

San Francisco, California, March 30, 1913 (Van Dyke), March 30, 1919 (Van Duzee), and April 20, 1913 (Van Dyke). Also one labelled "Golden Gate Park, San Francisco, April 21, 1912 (J. C. Thompson)."

Male: Length hardly 8 mm., more slender; head and thorax with much white hair, not tinged with ochreous; clypeus green at base, rosy in middle, black at apex, where it is strongly bigibbous; supraclypeal area bluish green, shining; flagellum long, moniliform, dull red beneath; mesothorax and scutellum shining, but closely punctured; wings clear; tarsi dark. Taken at San Francisco, October 29, 1911 (Van Dyke).

A completely isolated species in our fauna, having the appearance of the South American genus Pseudagapostemon Schrottky, but differing in the simple hind spur of hind tibia. There is a slight general resemblance to *H. aquilæ* Ckll., from New Mexico.

Type: Female, No. 1650, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, March 30, 1913, at **San Francisco, California.**

12. **Halictus ovaliceps** Cockerell

Females: Meadow Valley, Plumas County, California, 3500-4000 ft., June 5 (Van Dyke); Nanaimo, B. C., Biological Station, June 23 (Van Duzee). The British Columbia specimen has the flagellum almost entirely black and the first abdominal segment dark except the broad apical margin.

13. **Halictus aspilurus** Cockerell, new species

Female: Length 7 mm.; anterior wing about 4.6 mm.; head, thorax and legs black; abdomen shining, very bright ferruginous; basal part of first tergite infuscated, black at sides, other segments with dusky suffused spots at extreme sides, the apex red without spots; hair of head and thorax very scanty, white, long and erect on mesopleura, forming a narrow, dense fringe along upper margin of prothorax and about tubercles; mandibles with about the apical half dark red; head broad, about circular seen from in front; clypeus shining, very sparsely punctured; front dull, excessively closely and minutely punctured; flagellum obscurely reddened beneath toward end; mesothorax and scutellum shining, with very minute punctures, quite dense on mesothorax; area of metathorax semilunar, microscopically reticulated; posterior truncation shining; tegulæ rufous with dark base; wings hyaline, faintly reddish; stigma large, reddish sepia; nervures rather pale brown; first recurrent meeting second intercubitus; second cubital cell very broad below; legs with whitish hair; hind spur pectinate; abdomen without hair-bands.

Resembles *H. ovaliceps,* but easily known by the round head. From *H. arizonensis* Crawford it is known by the character of the pubescence and the entirely red apical part of abdomen.

Type: Female, No. 1651, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 22, 1920, at **Pleyto, Monterey Co., California.**

14. **Halictus farinosus** Smith

Female: Santa Monica, California (F. C. Clark). The hind spur of the hind tibia is serrate; in the closely related *H. lerouxii* Lep. it is dentate.

Female: Tuolumne County, California, June 16 (W. M. Giffard).

15. **Halictus (Seladonia) catalinensis** Cockerell

Female: Santa Cruz Island, California, May 16 (Van Duzee). Described from Catalina Island.

16. **Halictus vanduzeei** Sandhouse & Cockerell

Two females, La Paz, June 29 (Ferris). These have the face narrower than the type, but otherwise agree.

17. **Agapostemon digueti** Cockerell

Numerous males, La Paz, June 29 (Ferris).

18. **Agapostemon texanus vandykei** Cockerell, new subspecies

Female: Size of *A. texanus*, but yellowish green, with strong and beautiful golden reflections on face and abdomen; hair of head and thorax pale ochreous; wings dusky all over with a reddish tint. Less conspicuous features are the broader face, more finely plicate area of metathorax (with slight indications of a differentiated median space) and more finely striate posterior truncation. It does not resemble *A. texanus iowensis* Ckll., and compared with that form, the striæ on truncation of metathorax are much more nearly vertical (less transverse). The area of metathorax is more like that of *A. texanus subtilior* Ckll., but that form is quite differently colored. From *A. borealis* Crawford, which is another segregate from *A. texanus*, the present form will be known by the smaller size and golden (instead of bluish) reflections.

As the three specimens are alike, we doubtless have a distinct subspecies or race.

Type: Female, No. 1652, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, June 25, 1921, in **Yosemite Valley, California.** *Paratypes,* two females, same place, July 1, 1921.

19. **Sphecodes arvensiformis** Cockerell

Males: Lagoon, Utah, June 30 (Van Duzee); Sobre Vista, Sonoma County, California, May 12 (J. A. Kusche). *S. arvensiformis* was described from the female. These entirely black males are referred to it on the basis of probabilities, but the reference should be confirmed by biological observations.

They very closely resemble the male of *S. arvensis* Patton, but are distinctly larger, with darker wings, and more robust flagellum. The Utah form differs from that of California by the uniformly dusky wings, those of the latter being pale, with the apical margin broadly dusky. In the California specimen the first recurrent nervure meets the second intercubitus; but one Utah specimen has the second cubital cell rather broad, with the recurrent nervure near its end, while the other has the cell narrow, and the recurrent near the middle. I extracted the genitalia from the California specimen and the Utah one with broad second cubital, and do not see any material difference. Females of *S. arvensiformis* have the second cubital narrow. As matters stand at present, it appears necessary to refer these black males to *S. arvensiformis,* but future work may prove the existence of more than one species of this alliance in the region concerned.

20. **Perdita pyrifera** Cockerell, new species

Female: Length about 5.5 mm.; head and thorax green, the mesothorax shining yellowish green, and very sparsely punctured; wings remarkably short, strongly dusky, stigma and nervures sepia brown; abdomen flattened, dullish, entirely light yellowish ferruginous except a pair of suffused black spots on first segment, and a black line at each extreme side of second; the second and third segments may show suffused and faint traces of transverse yellowish bands; head ordinary, facial quadrangle longer than broad; no supraclypeal or dog-ear marks; clypeus shining black, sparsely punctured, with a very slender median pale line (sometimes reduced to a dot) on upper part; labrum black, prominent, concave in middle; mandibles light yellow, black at end; lateral face marks large, very pale yellow, pear-shaped, the very acute upper end on orbit at about level of antennæ; flagellum pale yellowish beneath; front dull; cheeks unarmed; tubercles and two marks on upper border of prothorax light yellow; pleura shining; tegulæ dark in front, very pale behind; second cubital cell very large, greatly narrowed above; anterior and middle femora robust; legs black, or very dark brown; anterior and middle knees, and broad stripe down their tibiæ in front, pale yellow.

Runs in my table next to the much smaller and quite different *P. chamæsarachæ* Ckll. Superficially, it resembles *P. ruficauda* Ckll., but is easily separated by the polished mesothorax, and first recurrent nervure joining second cubital cell a short distance from base, instead of meeting the intercubitus.

Type: Female, No. 1653, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 22, 1920, at **Pleyto, Monterey Co., California.** *Paratypes,* two females, same data.

21. **Perdita claypolei** Cockerell

Female: Mt. San Antonio, California, 5000 ft., at flowers of *Eriogonum fasciculatum,* August 22 (Timberlake). The head and thorax are yellowish green instead of blue-green as they are in a cotype from Mt. Lowe.

22. **Perdita exclamans imperialis** Cockerell, new subspecies

Female: Lateral face-marks linear above, not reaching level of ocelli; bands on abdominal segments narrower, those on second and third like those on fourth and fifth. The hind margin even except for a broad median notch, and the oblique extensions at extreme sides to edge of abdomen; yellow mark on lower part of cheeks reduced to a small spot.

Type: Female, No. 1654, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 8, 1923, at **Potholes, Imperial Co., California,** on mesquite. Typical *exclamans* Ckll. also visits mesquite.

23. **Perdita cleomellæ** Cockerell, new species

Female (type): Length about 4 mm.; head and thorax shining dark green, with white or cream-colored markings, the mesothorax and scutellum very highly polished; head ordinary, cheeks unarmed; labial palpi with last three joints together shorter than first; labrum, mandibles (except apically), clypeus, quadrate supraclypeal mark and lateral marks forming broad bands ending obliquely at level of antennæ, white; cheeks dark, with white hair; no dog-ear marks; scape creamy-white; flagellum dark, pallid beneath, and the tip pallid above; collar and tubercles cream-color; tegulæ hyaline with a white spot; wings clear hyaline, stigma and marginal cell margined with brown; first four legs and hind femora cream color, hind tibiæ and tarsi blackish, the tibiæ pale at base; abdomen cream-color with four entire black bands; apical plate red; venter entirely pale.

Male: Length a little over 3 mm.; face polished, entirely creamy-white below antennæ, the lateral marks extending some distance up sides of front, ending very obliquely; flagellum light brown above, pale yellow below; hind tibiæ pale yellow; abdomen with five bands, but they are more or less brown, especially the last two.

August 14, 1925

Both sexes at flowers of *Cleomella obtusifolia;* Barstow, California, September 12, 1924 (P. H. Timberlake). Numerous specimens were taken on the flowers. The female comes close to *P. interserta* Ckll., from Los Angeles County, California, but is easily separated by the small size and white markings. There is also some resemblance to the much larger *P. townsendi* Ckll. The male shows some resemblance to *P. exclamans atramentata* Ckll., from Sonora. Two paratypes have been deposited in the collection of the California Academy of Sciences.

24. **Perdita timberlakei** Cockerell, new species

Female (type): Length slightly over 4 mm.; head and thorax shining dark blue-green, yellowish green or mesothorax; head small, without light markings, but mandibles ferruginous beyond base, scape pale yellow in front, flagellum dusky reddish beneath; upper border of prothorax and tubercles pale yellow; tegulæ hyaline, with a yellow spot; wings hyaline, stigma and marginal cell dusky-margined; legs black, with the anterior tibiæ very broadly light lemon-yellow in front, their tarsi pale reddish; middle tibiæ with a yellow stripe; abdomen black, with four lemon-yellow bands, only the first reaching the lateral margins; first segment yellow at base, and this connected with a large discal more or less trilobed yellow spot; venter brown.

Male: Length about 3 mm.; face below antennæ, labrum and mandibles, clear white, the lateral marks extending to a point about half way up front; scape robust, light yellow in front; flagellum light yellow beneath; yellow on upper border of prothorax reduced to a spot at each corner; anterior and middle femora yellow beneath; first four tibiæ yellow, hind tibiæ yellow in front; abdomen dark brown, with yellow bands at bases of second and third segments, and vestiges of one on fourth.

At flowers of an annual Eriogonum, Riverside, California, September 24, 1924 (P. H. Timberlake). Runs in the tables near to *P. subfasciata* Ckll. and *P. punctifera* Ckll., but is quite distinct. It is not at all allied to *P. florissantella* Ckll., which visits Eriogonum in Colorado. Two paratypes have been deposited in the collection of the California Academy of Sciences.

25. **Perdita vittata** Cockerell

Two females, La Paz, June 29 (Ferris).

26. **Spinoliella peninsularis** Cockerell

Very many specimens, both sexes, La Paz, June 29 (Ferris).

27. **Spinoliella edwardsii** (Cresson)

Male and female: Huntington Lake, California, 7000 ft., July 10 (Van Duzee). The female is of the form *lateralis* (Cresson); male, Fallen Leaf Lake, Lake Tahoe, July (L. S. Rosenbaum).

28. **Spinoliella scutellaris** (Fowler)

Both sexes; Salt Lake City, Utah, June 25 (Van Duzee); male, Lagoon, Utah, June 30 (Van Duzee); females, Logan, Utah, July 18, and Saltair, July 12 (Van Duzee). The male is easily known by the abruptly dark apical part of the antennæ. The female was described by Fowler as *Calliopsis visaliensis*. The type of *S. scutellaris* was taken by Woodworth at Fresno, that of *visaliensis* by the same collector at Visalia, both on May 9.

It is now clear that *S. scutellaris peninsularis* Ckll. is a distinct species, *Spinoliella peninsularis*. The male, collected by Ferris at La Paz, June 29, has the flagellum white beneath to the end.

29. **Spinoliella anthidius** (Fowler)

Male: Bear Valley, San Bernardino Mts., California, July (F. C. Clark). Fowler's description is of the male, not female as he has it. The abdominal bands, broadly interrupted sublaterally, are very distinctive. This species has previously been known only from Fowler's type, collected by Woodworth at Tulare.

30. **Spinoliella triangulifera** Cockerell, new species

Female: Length slightly over 7 mm.; black, with cream-colored subequilateral triangular marks at lower corners of face, and large cream-colored spots at sides of first four abdominal segments, those on first two rounded, on the others transverse, pointed mesad; hair of head and thorax

quite long and abundant, grey, more brownish dorsally; clypeus shining, with irregular strong punctures, and a very inconspicuous median pale line, not extending more than half way down; flagellum obscurely reddish beneath; mesothorax highly polished, very sparsely punctured; tegulæ black; wings strongly greyish; stigma and nervures dark brown; abdomen broad, shining.

Type: Female, No. 1655, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, July 1, 1921, at **Yosemite Valley, California.**

Closely allied to *S. edwardsii* var, *lateralis* (Cress.), but smaller, the wings not so strongly reddened, more greyish, and the scutellum not excavated or depressed in middle. It is also related to *S. obscurella* (Cress.), but that species is larger, with flagellum bright ferruginous beneath, and continuous bands on abdomen.

31. **Spinoliella equina** Cockerell, new species

Female (type): Length nearly 7 mm.; black, with cream-colored markings; hair of head and thorax dull whitish, dorsally becoming brownish; eyes green; mandibles whitish at base, then red, apically black; labrum black; clypeus light, with a large black horse-shoe shaped mark (the arms ending on upper margin), from which there is a small projection on each side, or rarely the middle of clypeus is entirely black, except a small pale spot; superaclypeal and dog-ear marks present; lateral face marks very broad triangles with base on orbit, the upper point acute, level with antennæ; flagellum rather dull red beneath, except at base; mesothorax shining, sparsely punctured; post-scutellum and obscure spot on tubercles cream-color; tegulæ piceous; wings hyaline, very faintly dusky; stigma slender, very pale reddish, nervures brown; anterior and middle knees, and anterior tibiæ in front, pale yellow; anterior tarsi red; abdomen with cream-colored bands, interrupted on first two segments (very broadly on second), notched or slightly interrupted on third, entire on fourth; all these bands excavated sublaterally behind.

Male: Described by Swenk and Cockerell as the male of *S. hesperia*, but evidently belonging to the present species. *S. hesperia* Swenk & Ckll. must be restricted to the form described from the female, which has bright yellow markings.

The female resembles *S. australior* Ckll., but that species lacks the dog-ear marks (at each side of supraclypeal mark). and has the postscutellum black. The face-marks of female *S. equina* resemble those of the much larger *S. zebrata* (Cress).

Type: Female, No. 1656, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 21, 1919, at **Stockton, California.**

The above species of Spinoliella may be separated by the following key:

Lower side of flagellum with end broadly black or very dark, abruptly contrasting with the creamy-white before; males.......... .... *scutellaris* (Fowler)
Flagellum not thus colored.. 1
1. Clypeus entirely pale or with only a pair of black dots; males.. 2
   Clypeus not, or not all, pale; females........................... 4
2. Large species, fully 10 mm. long; face light yellow.............. ....*anthidius* (Fowler)
   Much smaller species.. 3
3. Flagellum dark or reddish beneath.........*edwardsii* (Cresson)
   Flagellum pale yellowish beneath...................*equina* Ckll.
4. No pale color at sides of clypeus, which has only a median pale stripe 5
   Sides of clypeus with large pale spots or all pale............... 6
5. Larger, wings reddish, scutellum excavated or depressed in middle ....*edwardsii lateralis* (Cresson)
   Smaller, wings greyish, scutellum not excavated or depressed in middle ....*triangulifera* Ckll.
6. Lateral face marks short, or reduced to dots.*scutellaris* (Fowler)
   Lateral face marks long, reaching to level of antennæ above.... ....*equina* Ckll.

32. **Calliopsis pugionis** Cockerell, new species

Female: Length a little over 7.5 mm.; black, with the anterior and middle knees shining yellow, an interrupted yellow band on upper margin of prothorax (but tubercles black), and lemon-yellow markings on face, as follows: triangular supraclypeal mark (highly polished and impunctate), lateral corners of clypeus broadly, and upper and lateral margins narrowly, with a dagger-shaped median line from the upper margin, hardly reaching half way to apex, and very broad lateral face-marks, separated from clypeus at upper part, and ending acutely on orbital margin above level of antennæ; face very broad; eyes deep green; mandibles red in middle; flagellum bright ferruginous beneath; hair of head and thorax largely white, but dorsally pale fulvous, short on thorax above; mesothorax closely punctured; base of metathorax highly polished; tegulæ dark brown; wings brownish, stigma and nervures brown; abdomen shining, with four white hair-bands, that on first segment broadly interrupted in middle; hind margins of segments rufescent; ventral segments with transverse depressions, deep on second.

Nearest to *E. coloradensis* Cresson, but easily separated by the color of the face-marks.

Type: Female, No. 1657, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 3, 1917, at **Soboba Springs, Riverside Co., California.**

33. **Panurginus atriceps** (Cresson)

Male: Carmel, Monterey County, California, March 25 (Van Duzee). Known by the entirely black face of the male, and the first recurrent nervure meeting first intercubitus, or even falling basad of it. It is related rather to *P. albopilosus* (Lucas), of Spain and Algeria, than to the other N. American species.

Females: Portland, Oregon, July 3 (W. M. Giffard).

34. **Hesperapis pellucidus** Cockerell, new species

Male: Length about 7 mm.; black, with abundant pure white hair; runs in my table and Crawford's to *H. larreæ* Ckll., which it very closely resembles, having the same size and appearance, clear wings, and long white hair covering clypeus. It differs thus: flagellum black, with at most a very obscure reddish tint beneath; mesothorax more distinctly punctured; extreme base of metathoracic area dull and granular; first recurrent nervure nearer base of second cubital cell, and much nearer to base than second to apex; basal nervure not so remote from nervulus; hind margins of abdominal segments with broad dense pure white bands of tomentum. The insect has the aspect of a small Colletes.

Numerous males from San Francisco, California, April 20-June 6 (E. P. Van Duzee and F. E. Blaisdell). There is a rather close general resemblance to *H. leucura* Ckll., from Lower California.

Type: Male, No. 1658, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 6, 1920, at **San Francisco, California.**

35. **Halictoides davidsoni** Cockerell

Many males from Huntington Lake, Fresno County, California, 7000 ft., July 4 to 28 (E. P. Van Duzee and F. C. Clark), and one from Cascada, Fresno County, 6000 ft., July 29 (Van Duzee). There are also two females from Huntington Lake, July 8 (Van Duzee). The female runs in my table (Entom. News, 1916, p. 62) to the same place as *H. mulleri* Ckll., but is readily known from that species by the absence of the broad bands of dull white tomentum at bases of abdominal segments, though there is a very slender band at base of fourth segment, only visible when the segment is much exserted. Other features are the greenish, highly polished and strongly punctured mesothorax, the long, black hair on clypeus, and the flagellum only very obscurely reddish beneath.

36. **Halictoides (Cryptohalictoides) spiniferus** (Viereck)

Males from Huntington Lake, Fresno County, California, July 9 to 28 (E. P. Van Duzee and F. C. Clark). Described from Nevada; Miss Stinchfield (now Mrs. Ferris) informed me that the female had been taken at Gem Lake, Calif.

37. **Halictoides virgatus** Cockerell

Male: Bradley, California, April 27 (Van Duzee).

38. **Halictoides mulleri** Cockerell

Male: Pyramid Park, El Dorado County, California, 8000 ft., August 8 (Van Dyke). In this specimen the scape is unusually stout.

39. **Halictoides holocyaneus** Cockerell, new species

Male: Length about 9 mm.; head, thorax and abdomen steel blue, the region below the ocelli yellowish green, and the abdomen greenish; legs also more or less metallic; hair of head and thorax abundant, dull white, with some dark hair at sides of face, and long dense pure white hair on clypeus; head broad, facial quadrangle broader than long; mandibles ferruginous at apex; lower part of front excavated in middle; antennæ

very long, dark, the flagellar joints modose, and obscurely reddish beneath between the modes; mesothorax shining, finely but not densely punctured; scutellum highly polished, hardly punctured in middle; base of metathorax roughened; tegulæ piceous; wings smoky hyaline, stigma and nervures reddish brown, the color dull; first recurrent nervure as far from base of second cubital cell as second from apex; legs with dull whitish hair, not greatly modified; middle femora stout; hind femora very stout, claviform; hind trochanters spined; hind tibiæ very robust; abdomen without hair bands, but with thin white hair on first three segments, and black beyond; fifth ventral segment with a cuneiform red area in middle.

Easily known by the blue color and relatively unmodified legs. It is much larger than *N. viridescens* Crawford, from California.

Type: Male, No. 1659, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, July 8, 1922, at **Baker, Oregon.** *Paratype,* one male, same data.

40. **Halictoides spilurus** Cockerell, new species

Female: Length about 7 mm.; head and thorax dark green; clypeus, antennæ and legs black; abdomen rufofulvous, the first segment black except apical margin, second black at sides, and suffusedly blackened in middle, third laterally very broadly black, but both second and third have broad depressed hyaline margins beyond the black, fourth and fifth with narrower black bands laterally, the black in all cases strongest along the hind margins of the elevated part of the segment, giving the effect of broad oblique stripes or bands; head, thorax and legs with long erect white hair, but much black on upper part of clypeus and scape, and on thorax above the hair is slightly yellowish; the hair is very long and spreading on hind tibiæ; head transversely oval, facial quadrangle much broader than long; mandibles obscurely reddish apically; clypeus transverse, shining, strongly but not very densely punctured; front and vertex granular; mesothorax shining, with close small punctures; scutellum polished, not so distinctly punctured; area of metathorax transversely broadly and deeply hollowed, channel-like, finely striate; tegulæ piceous, very dark; wings greyish hyaline, stigma and nervures dark brown; first recurrent nervure nearer to base of second cubital cell than second to apex; legs ordinary, spurs ferruginous; first abdominal segment polished, with very weak punctures; rest of abdomen shining, but less brilliant; apical tuft red; fourth ventral segment with a broad transverse depression.

Very distinct by the color and markings of the abdomen.

Type: Female, No. 1660, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 12, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft. *Paratypes,* two females, same place, July 22, 1919.

41. **Pseudomelecta californica** (Cresson)

Oracle, Arizona, July 24 (J. O. Martin).

42. **Ericrocis arizonensis** Baker

Oracle, Arizona, July 24, 1924, at sunflower (Van Duzee). Oracle is the type locality, the original specimens having been collected there by Osler.

43. **Triepeolus verbesinæ** (Cockerell)

Both sexes: Oracle, Arizona, July 24 (Van Duzee). One male is from sunflower.

44. **Triepeolus pacis** Cockerell, new species

Male: Length about 8.3 mm.; black, with the ornaments of head and thorax above very pale ochreous, of pleura, coxæ and face (which is densely covered with hair), white; scape black, very obscurely reddish at apex; flagellum bright ferruginous at extreme base (with a black mark on inner side), otherwise black; eyes dark grey; tegulæ bright ferruginous; wings dusky hyaline, nervures and stigma piceous; legs bright ferruginous, hind tibiæ suffused with dusky on outer side, but there covered with appressed white hair; hair on inner side of hind basitarsi light orange; hind spurs black or nearly so; apical plate of abdomen dark brown, long and nearly parallel-sided. Labrum dusky in middle, ferruginous at sides; mandibles red in middle; mesothorax with a pair of rather short stripes, reaching anterior margin, but not connected with marginal band, which only goes to anterior corners; scutellum strongly bigibbous; axillæ prominent; upper part of mesopleura with a broad transverse band of dense white hair, below this the surface is thinly hairy, the very dense punctures with shining margins visible; abdominal bands even and entire, except that the light hair at base of first segment is interrupted; black area on first segment a very broad band, ending very obliquely at sides; lateral corners of black on second segment rounded, not sharply acute; venter with much pure white hair, the outstanding fringe pale yellowish.

Related to *T. blaisdelli* Ckll. & Sandh., to which it runs in my recent table, but easily separated by the dark scape and flaggellum, the area of metathorax bare except at sides, the larger and darker stigma, etc. From *T. mensæ* Ckll. it is easily known by the color of flagellum, etc. The transverse band on first abdominal segment is much broader than in *T. noræ* Ckll.

Type: Male, No. 1661, Mus. Calif. Acad. Sci., collected by G. F. Ferris, June 29, 1919, at **La Paz, Lower California.**

45. **Oreopasites vanduzeei,** Cockerell, new species

Female: Length a little over 5 mm., with broad convex abdomen; head and thorax black, with white hair, shining silvery on face, sides of thorax and metathorax, thin on thorax above, not hiding surface; abdomen entirely clear ferruginous, with thin pure white hair-bands more or less developed at sides of segments; legs ferruginous, with the anterior femora darkened above, and the hind spurs dark; labrum, mandibles and lower edge of clypeus dusky red, the labrum elongated, broadly rounded at end; antennæ ferruginous beneath; tegulæ dusky red; wings hyaline, faintly dusky. I have not ventured to extract the mouth parts from the unique specimen, but they are extruded, and the labial palpi measure about as follows in microns: first joint 575, second 350, third and fourth each 50; the maxillary palpi clearly show five joints. I cannot demonstrate the basal tubercle-like joint which should be present. The marginal cell is considerably shorter than in *O. scituli* Ckll., and the mesothorax is strongly and densely punctured. The basal portions of the abdominal tergites are finely and densely punctured.

The only species previously known, *O. scituli,* was found to be parasitic on Spinoliella in Colorado. The new species was taken at the same locality, on the same day, as a quantity of *Spinoliella equina,* and with little doubt is parasitic in the nests of that bee.

Type: Female, No. 1662, Mus. Calif. Acad. Sci., collected by E. P. Van Duzée, August 21, 1919, at **Stockton, California.**

46. **Exomalopsis pulchella arida** Cockerell

A very long series, including both sexes, indicates that what I recorded as *E. similis* is, as I then suspected, only a variety of *pulchella.* Both *pulchella* and *similis* were described from Cuba, and presumably represent the variation of the species in

that island. The form from Lower California appears to be a distinct race for which the above name is available. Most of the specimens in the series now before me distinctly belong to *arida* as originally defined, but some have the hair of hind tarsi pale ferruginous, lacking the blackish or grayish color. La Paz, June 29 (Ferris).

47. **Exomalopsis (Anthophorula) chionura** Cockerell, new species

Female (type): Similar to *E. chlorina* Ckll. (from New Mexico), but eyes not or not distinctly green; stigma dark brown; mesothorax polished, without evident punctures (distinctly punctured in *chlorina*); white bands on second and third abdominal segments broader laterally. It is also very close to *E. texana* Friese, differing by the dark tegulæ (clear red in *texana*), dark stigma (pale amber in *texana*) and pure white (instead of creamy) hair on abdomen.

Male: Similar in most respects, but with narrower face; the clypeus (except two spots), labrum and basal part of mandibles pale yellow; flagellum long, dull ferruginous beneath. Compared with the male of *E. coquilletti* (Ashmead), it is readily separated by the shorter flagellum, and pure white hair on abdomen. The male of *E. chlorina* is unknown.

I hesitated whether to call this a distinct species, or a race of *E. chlorina,* but it seems best to regard it as a species, on account of the difference in the sculpture of the mesothorax. Presumably the closely related species of this group have different flower-visiting habits. *E. chlorina* is known to visit Sphæralcea (Malvaceæ).

Type: Female, No. 1663, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 19, 1919, at **Stockton, California.** *Paratypes,* four females, one male, same data.

48. **Diadasia nigrifrons epileuca** Cockerell, new variety

Female: Length about 8 mm., anterior wing 7.5; antennæ entirely black; pale hair of thorax above and of occiput, clear white, not ochreous; light hair of abdomen confined to first segment, the other segments with very little hair.

Type: Female, No. 1664, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 25, 1918, at **Sisson, Siskiyou Co., California.**

The forms assigned to *D. nigrifrons* are not all alike, the known females being separable thus:

Flagellum subtestaceous beneath; hair of thorax above and occiput pale ochreous; abdomen with pale hair only on first segment ....*nigifrons* (Cr.) proper.
Antennæ entirely black.. 1
1. Length about 8 mm.; hair of thorax above and occiput white; abdomen with pale hair only on first segment............... ....var. *epileuca* Ckll.
Length 10.5 mm.; hair of thorax above, and occiput ochreous; abdomen with pale hair on first two segments............. ....var. *nerea* (Fowler)

Whether these differences indicate well-defined races, or merely individual variation, is not at present known.

49. **Diadasia australis** (Cresson)

One male, San Antonio District, Lower California, July 12 (Ferris).

50. **Megachile pugnata pomonæ** Cockerell

Female: Huntington Lake, Fresno, California, 7000 ft., July 30 (Van Duzee).

51. **Megachile wootoni calogaster** Cockerell

Female: Huntington Lake, Fresno County, California, 7000 ft., July 16 (Van Duzee).

52. **Megachile fidelis** Cresson

Female: Kings River Cañon, Fresno County, California, July 6 (Van Dyke).

53. **Megachile perihirta** Cockerell

Ryer Island, Solano County, California, June 16 (F. H. Wymore). Three females reared from the nest, sent by Prof. E. O. Essig. The female of this species was described as *M.*

grindeliarum Ckll. Compared with Colorado specimens, the Californian bees differ a little in being distinctly less shining (especially on the abdomen) and by having the eyes (in dry condition) dark brown.

54. **Megachile vandykei** Cockerell, new species

Female: Length 13 mm., width of abdomen 5 mm.; entirely black, with entirely black coarse pubescence, very abundant on face and thorax above, thin on upper side of abdomen, which is of the short broad type; mandibles broad, quadridentate; clypeus transverse, convex, extremely densely rugosopunctate, with a polished shining spot at middle of upper edge, and a median band in which the surface is shining between the punctures, lower margin thickened, slightly emarginate in middle; cheeks broad and rounded; mesothorax with disc polished, with scattered rather small punctures; scutellum closely and finely punctured; area of metathorax short, dull, the metathorax beyond somewhat shining; tegulæ black, finely punctured; wings dilute brownish, nervures piceous; basal nervure meeting nervulus; hind basitarsi broad; abdomen shining, with scattered very fine punctures; ventral scopa entirely black.

Resembles *M. morio* Smith, but smaller. I have seen the type of *M. morio* in the British Museum; it is said to be from the "United States," but presumably came from Florida. There is a series of superficially similar black Megachile species in Peru. This is another melanic bee from Meadow Valley!

Type: Female, No. 1665, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, June 21, 1924, at **Meadow Valley, Plumas Co., California,** 5000-6000 ft.

Chelostomopsis Cockerell, new genus

Small bees allied to Chelostoma, but labial palpi four jointed, with two outstanding small joints; maxillary palpi three-jointed; lower margin of clypeus with a long median process, obtuse or truncate at end, parallel-sided; basin of first abdominal segment rather small, with a distinct rim; first recurrent nervure joining second cubital cell some distance beyond base. Type *Chelostomopsis rubifloris (Chelynia rubifloris* Cockerell).

True Chelostoma has only one outstanding small joint to labial palpi. This is also true of the subgenus Gyrodroma Thomson, type *nigricornis* Nylander. I designate *nigricornis* as the type of Gyrodroma, because of the confusion concerning

Thomson's other species, which he called *florisomnis,* whereas it was really *campanularum.*

Formicapis of Sladen has a process on clypeus, but it is broad-conical, and the position of the first recurrent nervure is quite different. The marginal cell of Formicapis is more narrowed apically.

In addition to the type species, the new genus includes *Chelostomopsis australis* (*Chelostoma australis* Cockerell). Only the female is known.

55. **Chelostomopsis rubifloris edwardsii** (Cockerell)

Female: Yorkville, Mendocino County, California, May 1 (Van Duzee). Typical *C. rubifloris* is from Seattle.

56. **Chelostomopsis australis nanus** Cockerell, new subspecies

Female: Length 6.5-7 mm. (typical *australis* about 9 mm.); wings distinctly dusky; area of metathorax polished and shining; red on second abdominal segment greatly reduced or wanting.

The type of *C. australis* was from near Los Angeles; the present form seems to be only a subspecies. The first recurrent nervure is much more remote from the base of second cubital cell than the second from apex of that cell. This is not the case with *Cephalapis jacintana,* which might perhaps be confused with it on account of the red at sides of base of abdomen.

Type: Female, No. 1666, Mus. Calif. Acad. Sci., collected by F. C. Clark, August, 1913, in **Bear Valley, San Bernardino Co., California.** *Paratype,* one female, same data.

57. **Cephalapis jacintana** (Cockerell)

Male: Bryson, California, May 18 (E. P. Van Duzee).

58. **Ashmeadiella howardi** Cockerell

Male: Bryson, Monterey County, California, May 18 (Van Duzee).

59. **Ashmeadiella crassa** Cockerell

Female: Mokelumne Hill, California, September 6 (Blaisdell). This is a larger, robust form, which may prove separable when the male is known. I have found quite parallel supposed variation in *A. meliloti* Ckll., but here also I am not without misgivings concerning the specific identity of the large and small forms.

60. **Chelynia rubi** (Cockerell)

Melanostelis betheli Ashmead is a synonym; Melanostelis may be regarded as a subgenus. Both sexes from Fallen Leaf Lake, California, June 26-July 26 (Van Dyke); Yosemite Valley, California, male May 15, female June 23 (Van Dyke); female, Meadow Valley, Plumas County, 3500-4000 ft., June 1 (Van Dyke). The original type female, from Seattle, has the light bands on first two abdominal segments very narrowly interrupted; they are not at all interrupted in the Californian specimens.

The male is only 6 to 7 mm. long, and has pure white hair on face, and much white hair on thorax; hair of pleura clear white.

61. **Chelynia franciscana** Cockerell, new species

Female: Length about 8 mm.; head and thorax green, abdomen blue-green, almost a peacock blue, the hind margins of the segments not purple; pubescence black; scape metallic; flagellum black, very faintly reddish beneath; mesothorax yellowish-green, shining, with coarse punctures; pleura blue-green, densely punctured; base of metathorax rugose; tegulæ green; wings strongly dusky; legs blue-green; middle tibiæ bidentate at end; abdomen polished, brilliant, the depressed hind margins of the segments much more finely and closely punctured than the part before; apical tergite not modified.

Allied to *C. pavonina* Ckll., but readily separated by the polished abdomen, with the hind margins of the segments not purple.

Type: Female, No. 1667, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 6, 1920, at **San Francisco, California.**

62. **Chelynia chlorocyanea** Cockerell, new species

Female: Length about 8 mm.; with deep rich peacock blues and greens, the head deep blue, becoming green between antennæ, mesothorax and scutellum blue suffused with green, pleura dark purple-blue, abdomen with first segment steel blue, the others green with hind margins of segments purple-blue, becoming black at edge; pubescence black, dense on face; scape dark blue; flagellum brownish beneath; mesothorax coarsely and closely punctured, the anterior middle prominent and shining; scutellum closely punctured; tegulæ blue, closely punctured; wings dusky; legs purple-blue; abdomen shining, but closely punctured, so that the whole surface appears roughened; in lateral view the hind margins of the ventral segments appear pale; last tergite not modified.

Close to *C. pavonina* Ckll., and perhaps only a variety or race, distinguished by the color of the thorax. *C. pavonina* occurs in Colorado.

Type: Female, No. 1668, Mus. Calif. Acad. Sci., collected by F. E. Blaisdell, in April, at **Mokelumne Hill, California.**

63. **Chelynia leucotricha** Cockerell, new species

Female (type): Length 7.5 to 9 mm.; head, thorax, abdomen and legs brilliant blue, suffused with greenish on clypeus, middle of front, and mesothorax; hair of head and thorax clear white, with black hairs sparsely intermixed, the white hair of face conspicuous; clypeus dull; scape blue, flagellum very obscurely brownish beneath; mesothorax with very large punctures, but shining between the punctures, which are not very dense on disc; scutellum shining, with large punctures; tegulæ blue-green; wings dilute fuliginous; abdomen shining but roughened, the hind margin of the first segment brilliant purple, of the others decreasingly purplish; hind margins of ventral segments appearing white in lateral view.

Male: Length 7 mm.; differing in the usual sexual characters.

Both sexes, Bear Valley, San Bernardino Mts., California, August 1913 (F. C. Clark). Huntington Lake, California (type locality), female, July 4, 1919, 7000 ft. (E. P. Van Duzee); Fallen Leaf Lake, July 14, 1915 (Van Dyke).

Related to *C. pavonina,* but easily known by the white hair on face.

Type: Female, No. 1669, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 4, 1919, at **Huntington Lake, Fresno Co., California.**

64. **Chelynia fragariella** Cockerell, new species

Male: Length about 6 mm.; not very robust, dark blue, the metathorax and region of ocelli greenish; abdominal markings cream color, consisting of bands across the first three segments, and a pair of short stripes on fourth; band on third segment narrowly interrupted, that on second constricted, all three bands shallowly emarginate sublaterally behind; head and thorax with outstanding white hair; scape slightly metallic, flagellum dark; mesothorax densely punctured; area of metathorax shining; tegulæ dark reddish, narrowly metallic in front; wings brownish hyaline; basal nervure going basad of nervulus; small joints of tarsi somewhat reddish; abdomen shining.

Related to *C. elegans* (Cresson), but much smaller, and differently colored.

Type: Male, No. 1670, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, August 5, 1912, at **Strawberry Valley, El Dorado Co., California.**

65. **Chelynia holocyanea** Cockerell, new species

Female: Length slightly over 6 mm.; bright steel blue throughout, shining; first three abdominal segments with narrow widely interrupted dull white bands, the third reduced to a pair of short transverse stripes, at least as far apart as the length of either; hair of head and thorax thin, mixed black and white; middle of face greenish; clypeus densely punctured; flagellum obscure brown beneath; mesothorax polished, with well separated punctures; area of metathorax shining; tegulæ blue, with a dark red spot behind; wings dilute fuliginous; abdomen shining; apex with black hair.

Related to *C. subcærulea* (Cresson), but much smaller, and with fewer markings on abdomen. It is also much more brightly colored.

Type: Female, No. 1671, Mus. Calif. Acad. Sci., collected by F. E. Blaisdell, July 12, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft.

66. **Chelynia nitidula** Cockerell, new species

Male: Length about 6.5 mm.; rich deep blue, with cream-colored bands on first four abdominal segments, and a pair of transverse marks close together on fifth; the band on first segment is constricted in middle, the others narrowly interrupted, and all are very shallowly excavated posteriorly on each side; hair of head and thorax white, mixed with black, entirely black on mesopleura; flagellum black; disc of mesothorax shining, with well separated punctures; area of metathorax shining; tegulæ very dark, submetallic; wings dilute fuliginous; abdomen shining. There is long black hair on the scutellum.

Related to *C. subcærulea* (Cress.) and *C. pulchra* (Crawford). From the former it is separated by the small size and large amount of white hair on thorax above, as well as the rich blue color. It is much smaller than *C. pulchra,* which occurs in the Rocky Mountain Region.

Type: Male, No. 1672, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 19, 1920, at **Bryson, Monterey Co., California.**

67. **Chelynia subglauca** Cockerell, new species

Male: Length about 6 mm.; similar to *C. nitidula,* but differing thus: head and pleura very dark blue, thorax above very dark green, abdomen almost black, but with a bluish tint, the second band not interrupted; hair of face, cheeks and pleura black, but of mesothorax entirely white; marginal cell broader in proportion to its length.

Probably a melanic race of *C. nitidula,* and also very close to *C. subcærulea.*

Type: Male, No. 1673, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, July 25, 1920, at **Paradise Valley, Mt. Rainier, Washington.**

The above species of Chelynia may be separated thus:

Black, with white bands on abdomen.....................*rubi* Ckll.
Blue or green.. 1
1. Abdomen without tegumentary bands........................ 2
   Abdomen with whitish tegumentary bands.................. 4
2. Hair of face light; end of abdomen obtuse (males) or acute (females)..............................*leucotricha* Ckll.
   Hair of face entirely black; females........................ 3
3. Abdomen more shining; head and thorax green.*franciscana* Ckll.
   Abdomen less shining, more punctured; head purple blue...... ....*chlorocyanea* Ckll.
4. Mesothorax densely punctured; hair of pleura pure white...... ....*fragariella* Ckll.
   Mesothorax shining, not densely punctured on disc............ 5
5. Hair of mesopleura white; white marks only on first three abdominal segments; female..................*holocyanea* Ckll.
   Hair of mesopleura black or dark grey; white marks or bands on five segments; males.................................. 6
6. Mesothorax bright steel blue.......................*nitidula* Ckll.
   Mesothorax dark green........................*subglauca* Ckll.

Subsequent work may show that some of these represent varieties or races rather than species, but at present no intermediates are known.

68. **Stelis laticincta** Cresson

Cascada, Fresno County, California, 6000 ft., July 29, 1 male, 1 female (Van Duzee); Cazadero, September 2, male (Van Duzee); Stockton, August 21, male (Van Duzee). Cresson described the female; I described the male in 1904. The species is very variable in the male, in the width of the bands along anterior orbits, the amount of yellow on the pleura, and the presence or absence of yellow on the sixth abdominal tergite. It seems probable that there are two or three separable races, but more material is needed to demonstrate this.

Mr. W. M. Giffard collected in Santa Clara County, California, July 16, a female *S. laticincta* agreeing with Cresson's description in having the clypeus black with a yellow spot on

each side. A female from Cazadero, California, has the clypeus yellow with the upper margin broadly black.

69. **Stelis sexmaculata** Ashmead

Male: Blue Lakes, Lake County, California, May 16 (Van Duzee). The specimen has eight spots on the abdomen, as is frequently the case.

70. **Stelis carnifex** Cockerell

Female: S. Sonoma County, California, June 26 (Kusche); compared with the cotype from Nevada, the face is wider and the head more densely punctured.

Male: Phillips Station, Placer County, California, July 24 (Blaisdell).

This species, as now understood, appears to be very variable. Additional material may show that it should be divided.

71. **Stelis montana** Cresson

Both sexes, Oregon, the male Warner Mts., Lake County, June 19 (Van Dyke); the female Wallowa Mts., Baker County, July 6 (Van Dyke); female, Park City, Utah, July 3 (Van Duzee).

72. **Stelis callura** Cockerell, new species

Male: Length 9 mm.; very robust, dark rich purple, including legs, greenish in middle of face, particularly supraclypeal area, flushed with greenish on mesothorax and scutellum, middle of postscutellum entirely green; pubescence entirely black; facial quadrangle much longer than broad, clypeus excessively densely punctured; scape green, flagellum black; mesothorax densely punctured, but shining between the punctures on disc; tegulæ largely metallic, strongly punctured; wings hyaline, more or less stained with brown along the veins, which are black; second recurrent going well beyond end of second cubital cell; abdomen with very rich purple (rosy-purple) suffusion.

Related to *S. carnifex* Ckll., but much larger than the male of that species, and with paler wings.

Type: Male, No. 1674, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 24, 1922, in **Parley Cañon, Salt Lake City, Utah.**

73. **Stelis fremonti** Cockerell, new species

Females: Length fully 10 mm.; similar to *S. montana*, but larger and more robust; mesothorax dull and more densely punctured; first recurrent nervure joining second cubital cell at a distance fully equal to half length of intercubitus; face strongly suffused with purple; abdomen rich deep indigo blue, very densely punctured.

Perhaps a race of *S. montana*, but apparently distinct.

Type: Female, No. 1675, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, June 18, 1922, in **Fremont National Forest, Klamath Co., Oregon,** at 5000 ft.

The above species of Stelis may be separated thus:

Blue or green, with no marks on abdomen, and with black hair on face	1
Without metallic colors	6
1. Small, about 7 mm. long; males	2
Larger, 9 mm. or over	3
2. Abdomen shining, not very densely punctured; mesothorax olive green	*montana* Cresson
Abdomen very densely punctured; mesothorax blue	*carnifex* Ckll.
3. Abdomen shining green; females	*montana* Cresson
Abdomen blue or purple, less shining	4
4. Abdomen deep purple· wings nearly clear	*callura* Ckll.
Abdomen rich blue; wings dilute fuliginous	5
5. Larger; mesothorax dull and more densely punctured	*fremonti* Ckll.
Smaller; mesothorax less densely punctured; female	*carnifex* Ckll.
6. Abdomen black, with greenish-white lateral spots	*sexmaculata* Ashm.
Abdomen with entire deep yellow bands	*laticincta* Cress.

All except the two last belong to the subgenus Pavostelis Sladen.

74. **Xylocopa varipuncta** Patton

Both sexes; Soboba Springs, Riverside County, June 3 (Van Duzee).

75. **Xylocopa orpifex** Smith

Mt. St. Helena, Napa County, California, June 9 (Van Duzee); S. Sonoma County., male April 6, female July 10 (J. A. Kusche); Yosemite Valley, June (Van Dyke); Laurel Dell, Lake County, August 2 (Van Duzee).

76. **Xylocopa virginica** (Drury)

Plummers I., Md., May 25 (Blaisdell).

77. **Xylocopa californica** Cresson

Yosemite Valley, June 10 (Van Dyke); Carrville, Trinity County, California, June 29 (Van Dyke).

78. **Xylocopa arizonensis** Cresson

Fort Bliss, Texas, May 1 (J. I. Carlson).

79. **Bombus sonorus** Say

One from La Paz, June 29 (Ferris). Also taken by the Academy Expedition at La Paz, June 28; Tiburon Island, (Academy Expedition), July 4 (Van Duzee); Sierra Laguna, 5400 feet, August 15.

80. **Ceratina tejonensis** Cresson

Male: Yorkville, Mendocino County, California, May 1 (Van Duzee). The apex of the abdomen presents an obtuse median projection, after the style of the much smaller *C.*

nanula Ckll., whereas according to H. S. Smith's key it should be more after the style of *C. dupla* Say. However, the specimen agrees with Cresson's description, and I think it is referable to his species.

Female: Shasta County, Calif., June 26 (J. A. Kusche). Known from *C. pacifica* H. S. Smith by the entirely green tubercles and absence of a large impunctate area on pleura.

PROCEEDINGS

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XII

EXPEDITION TO GUADALUPE ISLAND, MEXICO, IN 1922

GENERAL REPORT

BY

G. DALLAS HANNA

Curator, Department of Paleontology

INTRODUCTION

At the Berkeley meeting of the Pacific Division of the American Association for the Advancement of Science in 1921 there was appointed a "Committee on the Conservation of Marine Life of the Pacific," Dr. Barton Warren Evermann, Chairman.[1] The first task which the Committee undertook

[1] The full membership of the committee was as follows when the expedition was organized:

DR. BARTON WARREN EVERMANN, *Chairman*, California Academy of Sciences, San Francisco, Calif.
DR. G. DALLAS HANNA, *Secretary*, California Academy of Sciences, San Francisco, Calif.
W. E. ALLEN, Scripps Institution for Biological Research, La Jolla, Calif.
A. W. ANTHONY, Museum, San Diego Society of Natural History, San Diego, Calif.
PROFESSOR WM. A. BRYAN, Museum of History, Science and Art, Los Angeles, Calif.
DR. HAROLD C. BRYANT, Museum of Vertebrate Zoology, Berkeley, Calif.
PROFESSOR JOHN N. COBB, College of Fisheries, University of Washington, Seattle, Wash.
CAPT. W. C. CRANDALL, Scripps Institution for Biological Research, La Jolla, Calif.
DR. C. MCLEAN FRASER, University of British Columbia, Vancouver, B. C.
DR. HAROLD HEATH, Stanford University, Calif.
DR WM. E. RITTER, Scripps Institution for Biological Research, La Jolla, Calif
NORMAN B. SCOFIELD, California Fish and Game Commission, San Francisco, Calif.
ALVIN SEALE, Steinhart Aquarium of the California Academy of Sciences, San Francisco, Calif.
PROFESSOR EDWIN C. STARKS, Stanford University, Calif.
DR. F. B. SUMNER, Scripps Institution for Biological Research, La Jolla, Calif.
DR. WALTER P. TAYLOR, U. S. Bureau of Biological Survey, care Scripps Institution for Biological Research, La Jolla, Calif.
WILL F. THOMPSON, California Fish and Game Commission, San Pedro, Calif.

was the making of recommendations to the proper authorities for the conservation of certain of the marine mammals of that ocean. In the case of a few species, such as the Alaska fur seal, there existed sufficient authoritative information in governmental reports to enable the advocation of certain measures which, it was believed, would aid materially in bringing them back to their former abundance and commercial importance.

But with other species practically nothing was known of their present status or condition; indeed, the very existence of some of them was in doubt. The Committee at once proceeded to devise means whereby this deficiency could be filled in order that definite facts might be available for it to use in urging measures of protection. This absence of late information was notably true in respect to the Guadalupe elephant seal, Guadalupe fur seal and southern sea otter, all of which once existed in great abundance along the shores of California and Lower California. The latest data in respect to them had been secured many years ago and was not sufficiently recent, it appeared, to warrant an active campaign for the preservation of the species.

Therefore, through the activities of the Committee, an expedition was dispatched from San Diego, California, on July 9, 1922, to the islands off the west coast of Lower California for the primary purpose of securing information in regard to the three above-mentioned species of sea mammals. The following institutions actively cooperated in the enterprise:

National Government of Mexico,
California Academy of Sciences,
San Diego Society of Natural History,
Scripps Institution for Biological Research,
National Geographic Society.

The Government of Mexico provided the Fisheries Patrol Boat *Tecate* for the work and met all expenses while the party was in the field; and that country was represented by the following official personnel: Professor Carlos Cuesta-Terron, Curator of Fishes and Reptiles of the National Museum of Mexico, in charge of the expedition; Professor José M. Gallegos, Explorer of the National Museum of Mexico; Sr.

Joaquin Palacios, Inspector of Lighthouses; Sr. Rudolpho Lascano, Assistant Inspector of Lighthouses; Sr. Enrique Gonzales, Inspector of Fisheries; and Sr. Luis Rubio, Taxidermist.

The Committee was represented by the writer (Secretary) and Mr. A. W. Anthony. They also represented the California Academy of Sciences and the San Diego Society of Natural History, respectively, and were placed in charge of the scientific work of the expedition. Advantage was taken of this exceptional opportunity to secure scientific data in other branches of natural history in this little known and seldom visited region. Mr. Joseph R. Slevin, Assistant Curator, Department of Herpetology, and Mr. Frank Tose, Chief Taxidermist, accompanied the expedition from the California Academy of Sciences. Mr. Ernest Hinkley went from the San Diego Society of Natural History. The Scripps Institution for Biological Research, being actively engaged in oceanographic studies of broad scope, sent Mr. P. S. Barnhart for the systematic collection of water and plankton samples and ocean temperatures.

The motor ship *Tecate* was admirably suited to the work in hand and the success of the expedition was in no small measure due to the constant interest of Captain Victor Angulo and his well trained crew. Everything possible was done to aid the observers and collectors during the five weeks in the field. (See pl. 15, fig. 1.)

The expedition returned to San Diego on August 16 after having visited the following desert islands: Guadalupe, San Martin, Cedros, the three San Benitos, Natividad, San Roque, Asuncion, Magdalena, and Santa Margarita. Landings were also made at Ensenada, San Quintin Bay, San Bartolome Bay and Abreojos Point on the Peninsula of Lower California. Besides making observations and extensive collections of natural history specimens at all of these places, the coast line was studied at close range for considerable distances from the vesel, particularly around the long bight known as San Cristobal Bay where elephant seals are known to have once hauled out on the sands in abundance. Also a large number of samples of

September 5, 1925

animal and plant life of the open ocean (plankton) and temperature records were systematically collected.

Specimens were obtained in the various groups in approximately the following numbers: birds and mammals, 300; reptiles and amphibians, 1000; insects, 1100; land shells, 2000; marine fossils, many; and miscellaneous fishes, invertebrates, and plants. These have all been submitted to specialists and the technical reports upon them will be published in due time. It is already known that numerous strange and rare forms of animal life are represented in the collections, many of them being entirely new to science. Readers interested in the subjects are referred to these final reports for complete and technical information. In the following pages an attempt has been made to give the most interesting features of these desert isles and the general results of our search for the fur seals, elephant seals and sea otters.

Organization

The organization of the expedition was largely the result of the activities of Dr. Barton Warren Evermann and Mr. A. W. Anthony, Directors of the California Academy of Sciences and the San Diego Society of Natural History, respectively. Through them the cooperation of the National Government of Mexico was obtained and the success of the undertaking was assured. It was understood informally that Sr. Ing. Ignacio Romero, Agente General de la Secretaria de Agricultura y Fomento, Tijuana, B. C., was an enthusiastic supporter of the enterprise from the start and aided in many ways in arranging the details necessary for the despatch of the *Tecate* and party.

The following general memorandum was prepared before departure of the expedition and was distributed for guidance in the work proposed.

"1. *Designation.*—The expedition will be known as the Expedition of the Committee on Conservation of Marine Life of the Pacific of the Pacific Division of the American Association for the Advancement of Science functioning under authority of the Committee on Pacific Investigations of the Division of Foreign Relations of the National Research

Council, and conducted under the patronage of the Mexican Government, the California Academy of Sciences, the Scripps Institution for Biological Research, the San Diego Society of Natural History, and the National Geographic Society.

2. *Personnel.*—The expedition will be made on the Fisheries Patrol Vessel *Tecate* which the Mexican government has generously detailed for the purpose, and will be under the general direction and supervision of Señor Carlos Cuesta-Terron of the National Museum of Mexico, who will have associated with him a number of scientific gentlemen of his country.

[American members of the scientific staff were then listed. See p. 217.]

The scientific investigations will be under the immediate direction of Messrs. Hanna and Anthony.

3. *Field of operations.*—Islands and their surrounding waters off the west coast of Lower California, particularly the islands of Guadalupe, San Benito, Cedros, and Natividad; also Magdalena Bay and other points on the mainland.

4. *Purpose.*—The primary purpose of the expedition is to make investigations to determine as fully as may be the present abundance and condition of the southern fur seal, southern sea otter, and elephant seal in the localities visited.

It is known that each of those three important and valuable marine mammals was at one time quite common not only about the islands mentioned but also about the islands on the California coast as far north as the Farallons. Records believed trustworthy show that in the years 1808 to 1811, more than 203,000 fur seals were taken on the Farallon Islands, besides many thousands on the Channel Islands, Cedros and other islands off the coast of Lower California. Records also show that the southern sea otter was at one time very abundant in the great kelp beds about these same islands, more than 22,000 having been taken prior to 1806. The elephant seal was once abundant on Guadalupe Island and on other islands on this coast.

It is generally believed that each of these interesting animals is now extinct or nearly so; but certain recent discoveries indicate that at least small remnants of each of the three species still exist. It is the purpose of this expedition to find out the facts in-so-far as is possible and place them before the State Departments of the United States and Mexican governments in the hope that the necessary steps may be taken by the two governments through an international treaty for the adequate protection of these valuable natural resources.

5. *Other scientific investigations.*—The scientists of this expedition will avail themselves of the exceptional opportunities for making a general survey of the fauna and flora and geology of the islands visited. They will be equipped for making collections in various branches of nat-

ural history, particularly of birds, mammals, insects, shells, botany, and fossils. These islands have been but little explored and it is believed that many new species will be discovered. Provision is made for taking photographs, both still and moving, adequate for illustrative and educational purposes."

(Signed) BARTON WARREN EVERMANN
Director of the Museum of the California Academy of Sciences, and Chairman of the Committee on Conservation of Marine Life of the Pacific.

(Signed) G. DALLAS HANNA
Secretary of the Committee on Conservation of Marine Life of the Pacific.

The National Geographic Society through its President, Dr. Gilbert H. Grosvenor, contributed the sum of $500.00 to aid in defraying the expenses of the expedition. This was used for photographic purposes with the understanding that prints from all official still-camera pictures should be furnished to the Society accompanying an article suitable for publication in its magazine.[2]

Of 360 exposures made with a 4x5 camera, 314 negatives were obtained, suitable for illustrative purposes. Prints of these were furnished to the National Geographic Society; the San Diego Society of Natural History; the National Government of Mexico; the California Academy of Sciences; and various members of the party. The negatives have been deposited in the latter institution. In addition to the above, several members of the party took photographs, prints of which were furnished to the Academy. About 800 feet of motion picture negative was made of the herd of elephant seals on Guadalupe Island. This has been deposited in the Academy and prints were furnished to the National Government of Mexico and the San Diego Society of Natural History.

Upon the completion of technical reports of the scientific collections obtained it was understood that an equitable division of specimens would be made among the institutions represented.

In addition to the account of the expedition published by the National Geographic Society, announcements giving major

[2] See—A Cruise among Desert Islands, by G. Dallas Hanna and A. W. Anthony. Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, pp. 70-99, 33 photographs. (Various portions of this article were widely quoted as for instance: Illustrated London News, Sept. 29, 1923, Vol. 163, No. 4406, pp. 564-565, 9 photographs.—Literary Digest, Vol. 79, No. 8, Nov. 24, 1923, pp. 50-52.)

facts appeared in *Science* and other publications before departure and after returning.[8]

ITINERARY

DATE	ARRIVED	PLACE	DEPARTED	REGION VISITED
JULY 9		San Diego	9 00 AM	
9	5 00 PM	Ensenada		
10		Ensenada	3 00 PM	
11	2 00 PM	Guadalupe Island		
12		Guadalupe Island		Elephant Beach
13		Guadalupe Island		Cypress Grove and South side
14		Guadalupe Island		Esparsa Cañon
15		Guadalupe Island		Pine Ridge
16		Guadalupe Island		Jack's Bay and south end
17		Guadalupe Island	5 30 PM	South end; east side
18	2 00 PM	San Quintin Bay		
19		San Quintin Bay		Santo Domingo
20		San Quintin Bay		
21		San Quintin Bay	4 00 PM	
22	10 00 AM	Cedros Island.		Bernstein's Abalone Camp
23		Cedros Island	7 00 AM	Bernstein's Abalone Camp
24	9 30 PM	Magdalena Bay		Village
25		Magdalena Bay		
26		Magdalena Bay		
27		Magdalena Bay	Noon	
27	3 00 PM	Santa Margarita Island		Village
28		Santa Margarita Island		Cactus Forest
29		Santa Margarita Island		Rancheria
30		Santa Margarita Island	9.00 AM	Village
31	1 00 PM	Abreojos Point		
Aug. 1		Abreojos Point	6 00 AM	
1	11 00 AM	Asuncion Island		
2		Asuncion Island.	6 00 AM	
2	7 30 AM	San Roque Island		
2		San Roque Island	11 00 AM	
2	6 00 PM	San Bartolome Bay		North part
3		San Bartolome Bay	6.30 AM	
3	9 00 AM	Natividad Island		
4		Natividad Island	6 30 AM	
4	9 00 AM	Cedros Island.		Bernstein's Abalone Camp
5		Cedros Island.		Bernstein's Abalone Camp
6		Cedros Island		Bernstein's Abalone Camp
7	6 00 AM	Cedros Island		Grand Cañon

[8] Evermann, Barton W. (Catalina Islander, Vol. 9, No. 28, pp. 1, 10, July 26, 1922.)
Evermann, Barton W. (Sports Afield, Vol. 69, No. 2, pp. 102-103, August, 1922.)
Evermann, Barton W. (Science, n. s. Vol. 56, No. 1440, pp. 135-137, August 4, 1922.)
Evermann, Barton W. (Pacific Fisherman, Vol. 20, No. 8, p. 16, August, 1922.)
Hanna, G. Dallas. (San Diego Union, Thursday, August 17, 1922.)
Hanna, G. Dallas. (Golden Gate Pathfinder, Vol. 3, No. 34, p. 2, August 27, 1922.)
Hanna, G. Dallas. (Golden Gate Pathfinder, Vol. 3, No. 38, p. 2, Sept. 24, 1922.)
Hanna, G. Dallas. (Golden Gate Pathfinder, Vol. 3, No. 40, p. 2, October 8, 1922.)
Hanna, G. Dallas. (Catalina Islander, Vol. 9, No. 37, pp. 6-7, September 27, 1922.)
Hanna, G. Dallas. (Science, n. s. Vol. 51, No. 1453, pp. 503-504, November 3, 1922.)
Evermann, Barton W. (Proc. Calif. Acad. Sci., 4th Ser., Vol. 11, pp. 665-667, August 22, 1923.)

Date	Arrived	Place	Departed	Region Visited
Aug. 8	1 00 AM	Cedros Island		North end
10	10.00 AM	Cedros Island		Bernstein's Abalone Camp
10		Cedros Island	3.00 PM	Bernstein's Abalone Camp
11	7.00 AM	Cedros Island		Abalone camp on west side
12		Cedros Island	7.00 AM	
12	9.30 AM	West Benito Island		
13		West Benito Island	8.30 AM	Middle Benito also
13	9.00 AM	East Benito Island		
13		East Benito Island	2.00 PM	
14	Noon	San Quintin Bay		
14		San Quintin Bay	2.30 PM	
14	5 30 PM	San Martin Island		
14		San Martin Island	7 00 PM	
15	9.00 AM	Ensenada		
15		Ensenada	11.30 AM	
16	9 00 AM	San Diego		

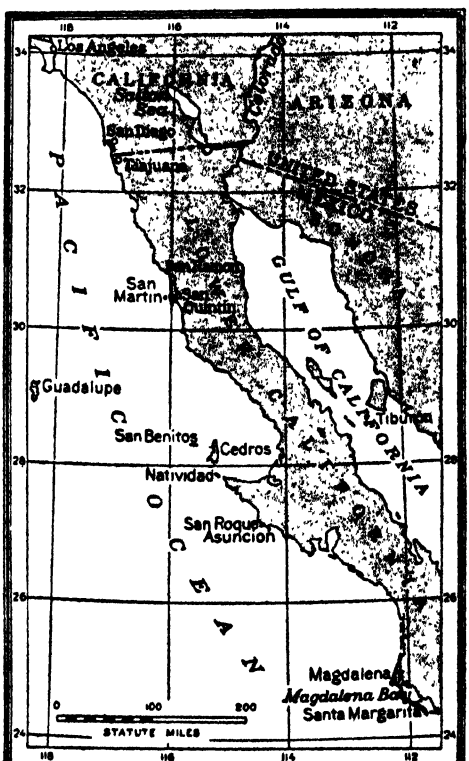

Fig. 1. A sketch map showing the region visited by the expedition of 1922; drawn by James M. Darley; from National Geographic Magazine, July, 1923.

The region covered in the above itinerary is included in the following series of sailing charts of the Hydrographic Office of the U. S. Navy;[4] it is therefore not believed necessary to reproduce a general map of the area other than the sketch shown above.

Area covered	*Chart number*
General, West Mexico	1006
San Diego to San Quintin Bay	1149
San Quintin Bay to Cedros Island	1193
Cedros Island to Abreojos Point	1310
Abreojos Point to Cape San Lazaro	1493
Cape San Lazaro to Cape San Lucas	1664
Cape San Lazaro to Cape San Lucas	621
Todos Santos Bay	1046
Guadalupe Island	1681
Hassler Cove	1686
San Quintin Bay	1043
Cedros Island	1192
San Benito Islands	1194
San Bartolome Bay	1204
San Ignacio Lagoon	1492
San Roque and Asuncion Islands	1268
Magdalena Bay	1636

The night before the Expedition left, the members gathered around a dinner table at La Jolla and listened to an exposition of its aims and objects given by various persons directly interested in it. Informal talks were given by Dr. Barton Warren Evermann, Sr. José M. Gallegos, Dr. Fred Baker and others.

Next morning, July 9, at nine the lines of the *Tecate* were cast off at San Diego and Ensenada was reached at five the same day. The Mexican officials were hosts at a dinner given to the rest of us that evening. At three p. m. of the tenth the last of the stores had been taken aboard and the ship was headed toward Guadalupe Island, 170 miles to the southwest.

Off Point Banda there are 10 rocks, white from the occupancy of them by various birds, chiefly brown pelicans, Brandt's cormorants and western gulls. Eight of these rocks were occupied by California sea lions, the total number being estimated

[4] See, "Mexico and Central America Pilot (West Coast)," Hydrographic Office, U. S. Navy, Publication No. 84, 6th Edition, 1920, and Supplement to same issued in 1923. In each of these there is an index map of the area covered; on this map all of the charts issued by the office are indicated.

at 250. Close watch was kept for sea otters and fur seals in the kelp beds as the *Tecate* passed close inshore here but, as was to be expected, none was seen. Formerly both species lived at this point in great abundance and it is not so many years ago that 30 sea otters were killed; this was the last time a large number was slaughtered. Since then the species has been practically extinct and in a region where a century and a half before thousands were killed in a single season.

Before darkness closed in about the little motorship, two red phalaropes were seen feeding on the sea. They were in full fall plumage and it seems incredible that they had been to the breeding grounds in northern Alaska and had returned this far south already on the fall migration. They must surely have remained behind the great flocks which annually follow the American coast to the Arctic regions.

On the 11th, at ten a. m., Mr. Slevin, with eyes trained to the sea, announced Guadalupe Island in sight. Two hours later, between banks of fog, the ruggedness of the black scorched cliffs of the north end was in plain sight and at three p. m. we landed at the place called "Northeast Anchorage."

A settlement had formerly been at this place; sometimes it consisted of soldiers and their families; again the occupants were those trying to successfully exploit the goats of the island. At this time the place was not inhabited but one of the sheds almost filled with dried meat and skins indicated that people had occupied the place not more than one or two years previously. The best of the buildings was a two story adobe house used by officers of the military party; it was painted white.[5]

On the trip across from Ensenada, Mr. Barnhart and I alternated taking samples of water from the surface of the sea. These water samples were collected by tying a small bottle to the bottom of a silk net. Three full buckets of known capacity were poured into the net, the plankton collecting in the bottle. The minute animal and plant life was killed and preserved with formalin, a label was added and the sample packed away for use of Dr. W. E. Allen in oceanographic study. These samples were taken every hour during the cruise, when the vessel was under way.

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[5] See fig. Nat. Geog. Mag., Vol. 44, No. 1, p. 72, July, 1923.

While camp was being established on shore, Mr. Slevin and I walked up the cañon back of the buildings about a mile. The country is excessively rough and shows evidences of volcanism on a grandiose and awe-inspiring scale on every side. Huge caves and caverns festooned with ragged lava line the cliffs on both sides of the cañon. In some places strata of scoria, cinders and loose rocks are bedded as if they might have fallen in water from a spouting volcano. Subsequent to deposition the beds were violently disturbed because it is not unusual to see the dip of the strata change 90° in 100 yards. No fossils of any kind were found so it cannot be certain that any of the material was laid down in the sea.

The cañon showed evidence of considerable water at a not very distant date. Large water holes, lined with fresh sediment were in the bed of the stream but not a spot now appeared to be moist. All of the vegetation in that vicinity was likewise dry except the poppies and one or two other kinds of plants. Wild oats, waist high, grew in profusion where there was soil. Goats were excessively abundant everywhere and were well fed. Doubtless there had been sufficient rain in earlier months to produce plenty of pasturage. But the dried bleached bones strewn over the ground in greatest profusion showed that famine had spread over the herd in other years and had taken enormous toll. Probably, as in most of Lower California and the outlying islands, rain is scant and very irregular on Guadalupe. Certainly the greatest part of the island is a desert of the most barren sort.

No cats were seen during the brief sojourn in the cañon that evening and during the rest of our stay on the island they successfully evaded us. Several skulls were collected at various places. Mr. Hinkley took one from a well (salty) at the landing place. Another was later found at the extreme south end of the island showing that this pest has completely overrun the place. Escaping as pets or abandoned by former occupants, this animal has reverted to the wild state and has wreaked havoc among the birds. We saw evidence of this everywhere we went. The Kaeding's petrels were apparently preyed upon the most. The action of the cats could be plainly read from the record on the ground. The petrels live among the loose

rocks and in the holes of the cliffs, where the cats apparently have no difficulty in capturing them as they go and come. Many were seen with only the top of the head eaten away.

In this cañon we took five species of land snails: two Pupillidæ; two Micrarionta and the strange *Binneya notabilis* found elsewhere only on Santa Barbara Island, off southern California. Here on Guadalupe it is very abundant and appears to be identical in every way with those of the northern island. It is about halfway between a true snail and a slug. Many of the snail shells had been broken and the soft parts extracted by mice.

The house mouse is apparently very abundant all over the island; specimens were collected which do not differ from individuals of other lands. The species probably came accidentally with personal baggage, has increased enormously, and probably will completely exterminate the land shell fauna. Probably numerous species of insects have already disappeared through this agency. The cats, of course, will not eat the mice as long as they can subsist on birds.

Mr. Slevin looked carefully for lizards on many parts of the island but failed to find a single one. Prof. Cuesta-Terron stated that he had a report of a specimen having the characters of a Xantusia but it was not sufficiently reliable to be credited without supporting evidence. Mr. Slevin's failure to find a species of reptile of any kind naturally leads us to believe none lives there.

Late in the evening of July 11 an osprey was shot at the landing place; this species had not previously been reported from Guadalupe Island.

On the morning of July 12, with all hands on board the ship sailed around the north end of the island to the elephant seal rookery. On the way around, the beach was scanned at close range for Guadalupe fur seals but none was seen. Only in one place, a cave three-fourths of a mile north of the elephant seal rookery, did there appear to be any suitable ground where the fur seal might be expected. This was occupied by a few of the elephant seals.

The landing was made early in the forenoon at the northwest end of a short beach composed of black sand and on which

the elephant seals were located. Immediately back, huge, unscalable, lava cliffs rose to an elevation of 2000 feet. It was with much misgiving that we rowed in as quietly as possible, each moment expecting the animals to catch our scent or the noise of the oars and desert the place for the rest of the day. That invariably would have been the procedure if we had been approaching any of the northern rookeries of hair seals or sea lions I had visited. But they let the first boat load of us land without troubling themselves at all; the nearest ones, however, were some 50 yards away.[6] (See pl. 16, fig. 1.)

With motion picture equipment and Graflex camera we climbed a spur at the west end of the rookery and proceeded to take a series of pictures as rapidly as possible. Each turn of the crank and each snap of the camera I expected to be my last opportunity, but the lazy animals slept on. Other visitors coming ashore hid under a low cliff until the photography from the distance was finished. Some of them were then asked to walk slowly toward the herd. It was expected that a motion picture of them all rushing into the sea would prove an item of interest. Every one was equally surprised when the men walked right out among the huge beasts, slapping an occasional one on the back as a sign of greeting.

A count of the herd was made from this high point before the men went among the animals but it was subsequently discarded when it was found that a much more accurate census could be obtained from enlargements of some of the photographs. We thus determined the number present to be 264.

All of those present were males except one female. She was timid and left the beach soon after we arrived. It was noted that the long pendant snout of the male was represented in the female by a short and scarcely noticeable elongation. I do not believe the female can inflate her "trunk" as does the male and thus produce a resonance chamber or sound box to accentuate the ponderous snore-like sound the latter frequently make.

There was one young seal on the beach, perhaps a yearling, and its silvery coat of hair fairly glistened in the sun. It likewise deserted us soon after we made our presence known.

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[6] Anthony (Journal Mammalogy, Vol. 5, No. 3, Aug., 1924, pp. 145-152, pls. 17-20) has given an account of the elephant seal herd in 1922, 1923, and contributed other data of historical value.

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On the beach, down among the animals we made many close-range studies and photographs. (See pl. 16, fig. 2.) This was shedding time[7] and we were all much surprised to see some animals with large flakes of epidermis peeling off of their bodies, bringing the old hair with it. Much of this cast-off skin littered the beach. The underside of the neck of the well grown male was very greatly creased and corrugated, and the color was brilliant geranium pink. Otherwise the coloration was a somber drab or gray, like the unspotted hair seals to which they are somewhat distantly related. The corrugations on the necks have been called scars from fighting, but they seem to be too regular and uniform. I think it is purely a sexual character of the species. The only fighting scars I saw were on the backs.

The animals were all excessively fat. On those occasions when we were able to get one to go into the water, wrinkles or waves of fat traveled the length of the body as it moved on the sand, undoubtedly aiding in the movement forward or backward. In coming from the water great deliberation was shown, advantage apparently being taken of the last ounce of "push" in the breaking surf. Locomotion was exceedingly slow and laborious on land; the diminutive front flippers are used to a certain extent to pull the huge bulk forward but they and the muscles which actuate them are entirely inadequate. The hind limbs project backward at all times and while they are very serviceable in swimming they serve no useful purpose on land.

One curious habit we noticed on land was the throwing of showers of sand up over and on the backs as they lay stretched out. The front flippers, one at a time are used for this and in some cases an animal looked like a huge pile of volcanic sand with flippers projecting at one end and nose at the other. Why this is done remained to us inexplicable when we left.

On several occasions we succeeded in causing a full grown bull to raise his head and shoulders to their full extent; then they are considerably taller than a man. The teasing to which they were subjected caused only the mildest sort of protest. This consisted only of throwing the head back high over the

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[7] See figure in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, p. 77.

back and opening wide the mouth. On no occasion was an attempt made to bite one of us although ample opportunity was afforded had the animals been so disposed. How different were they in their docility from an equal number of fur seal bulls, which would have torn us literally to shreds under similar circumstances! On two or three occasions members of the party would place a hand on the back of an animal and vault over, rather than go around.

One of the strangest things to me about the elephant seals was the manner in which the snout (erroneously called trunk) was inflated, balloon-fashion, and allowed to dangle in the widely opened mouth when the head was thrown far back to utter the indescribably weird sound they make.[8] The noise (it can hardly be called a note), although of very low pitch, has peculiar carrying properties and the source is difficult to locate. So far as we could see the snout (about 12 inches long) was put to no other purpose. It can be of no value in the capture of food, else the young and females would likewise be thus provided.

The Mexican naturalists wished to obtain a specimen for their National Museum and this afforded an opportunity to investigate the food habits of the species. But the stomach was empty, except for some sand, and the natural food remains a mystery.

The breeding ground proper is at the southeast end of the beach and above high tide mark. Here were the remains of six dead animals, too far decomposed for careful examination. From them it was supposed that the ground had not been occupied probably later than March and perhaps earlier.

Many points in the life history of this strange beast remain unknown. For instance, where were the females and young? Certainly not around Guadalupe. It has been suggested that they migrate to the coast of Chile. This may be correct, but the animals seem ill adapted to so long a journey. Our observations indicated that they were not so adept in swimming as such species as the sea lions. They could hardly catch the incredibly swift pelagic fishes such as tuna, albacore, yellowtail, etc., which abound about Guadalupe. Moreover, there appeared

[8] See figure in National Geog. Magazine, Vol. 44, No. 1, July, 1923, p. 76.

to be no records of the species between Guadalupe and Chile. Truly this is an animal of mystery.

All of us were impressed with the apparent stupidity of the elephant seals. One man with a rifle could kill in a short time all of the herd then present. Years ago they were so butchered and the fat was rendered into oil. This continued to such an extent that the animal was supposed for a while to be extinct. It was very gratifying to us to see that there was at least a nucleus left to perpetuate the species and at least not yet will it follow the dodo and passenger pigeon into oblivion. After making due allowances for animals absent it would seem that the entire herd in 1922 must have contained not many fewer than 1,000[9] of all classes.

Upon our return to San Francisco the Committee under whose auspices the expedition was organized, took steps immediately to urge the Government of Mexico adequately to protect this relic of a bygone age of which it happened to be custodian. Our associates from that country took similar action and as a result on October 27, 1922, President Obregon issued the following proclamation declaring Guadalupe Island a reservation.

SUBJECT

Marginally a stamp which says:—United States of Mexico.—Presidency of the Republic.—Resolution of the Bureau of Agriculture and Public Works:

CONSIDERING

That the island of Guadalupe, of Lower California, and its territorial waters possess natural riches alike in forestry material and in herds, and in game and fish, numbering among its species many of rare occurrence, which species are in danger of extinction, owing to the immoderate exploitation of which they have been the object;

That the Federal Government must protect those species which constitute an inexhaustible fount of riches for the Government and the people of Mexico.

For that reason, I have considered it well to dictate the following

RESOLUTION.

Article 1.—The island of Guadalupe of Lower California, as well as the territorial waters surrounding it, remains reserved for the protection and

[9] Anthony (Journ. Mammalogy, Vol. 5, No. 3, Aug., 1924, p. 148) has stated that he believed 1250 total to be a conservative estimate of the herd in 1923, a year later.

development of the natural riches which they contain, alike in forestry material and in herds, and in game and fish.

Article 2.—There be named the technical and administrative personnel necessary for the administration and protection of the said riches.

Given in the residence of the Federal Executive Power, on the 19th day of the month of October of one thousand nine hundred and twenty-two.—THE CONSTITUTIONAL PRESIDENT OF THE UNITED STATES OF MEXICO.—A. OBREGON.—SEAL.—Published and executed.—THE UNDER SECRETARY OF AGRICULTURE AND PUBLIC WORKS COMMISSIONER OF THE BUREAU.—RAMON P. DE NEGRI.—Seal.

It is a copy which I certify agrees with the original.

MEXICO, October 27, 1922.

THE SECONDARY CHIEF CLERK.

GMO. S. SEGUIN.—Seal.

It is to be hoped that all loyal subjects of all civilized nations will respect this decree and permit the elephant seals to live their lives and perpetuate the species for the benefit of future generations of mankind.

After Mr. Tose had completed the making of the sketches he had in mind and had collected some accessory material, such as rocks, plants, dried elephant seal epidermis, etc., we sailed back to our shore camp. The articles mentioned were to be used for the preparation of a group of the mounted animals which the California Academy of Sciences had received several years previously and which was to be installed in the new Steinhart Aquarium, then under construction.

At the elephant seal beach, Mr. Anthony and others saw a wandering tattler fly listlessly from rock to rock in the most unconcerned and nonchalant manner. This bird has always been an enigma to me. I have seen it in summer on practically every north Pacific island I have visited from Guadalupe to the center of Bering Sea, and others have reported it as far south as the Revillagigedo group. Yet breeding records seem to be entirely wanting. It spends our winter months in the southern hemisphere and there is a possibility that its breeding ground is south of the equator.

On the way back from the elephant seal beach to our shore camp two yellowtail tuna were caught from the deck and proved to be a desirable addition to our already excellent bill of fare. The fishes were taken on a bone "gig" trolled far

behind the ship on a piano wire "leader" and very strong line. When a strike was made this powerful swimmer made the line fairly sing back and forth as it was hauled in, hand over hand. Such procedure would doubtless break the heart of a light tackle enthusiast but fishing for fun and fishing for food must always be separated.

That night as we were getting into our blankets at 10 o'clock under a starlit sky, we were greeted by a slight earthquake, lasting almost a minute—merely a gentle reminder of the immeasurable forces which have built this mountain peak from 12,000 feet beneath the waves to 4,000 feet above.

The next day, July 13, the party separated in order the better to cover more ground in our limited time. Messrs. Slevin, Gallegos, Barnhart and Hinkley, leaving in the early morning, took the trail up the cañon back of the buildings. After about six hours of steady, weary climbing, up the excessively rough lava slopes they eventually reached the forest of cypress trees near the top. Here Dr. Edward Palmer had camped in a veritable paradise in 1875. He found strange birds in abundance and a profusion of wild flowering plants.

No less than four species of the birds he found are now absolutely extinct and except for the museum specimens and his notes they are forever lost to humanity. There is some strange and lonely sadness that comes over us when we think of the last of a species of one of nature's creations having passed its span of existence. Paleontology tells us that hundreds of thousands of species have so passed on in times gone by; nevertheless, when we see one go we feel the loss the same as we do when a dear relative has received a last farewell.

The species of birds thus far exterminated on Guadalupe are: Guadalupe Caracara, Guadalupe Flicker, Guadalupe Towhee, and Guadalupe Wren.

The caracaras were abundant when Dr. Palmer was at the island but ten years later (1885), when Mr. Walter E. Bryant collected on Guadalupe for the California Academy of Sciences, he found them being killed by the soldiers stationed there "to protect the goats." It was evidently believed that the young kids were killed by the caracaras and, although the birds ranged from the sea shore to the highest peak, they were

soon all killed. The destruction was made easy because, it is said, the birds resorted to the water holes on top of the island to drink.

The other three lost species, the flicker, wren and towhee, have gone because they were unable to protect themselves from the house cats, running wild.

Our party saw no sign of any of these four species although special search was made for them. There was one other resident, the Guadalupe petrel, which we expected to find but did not. The last report of a naturalist previous to our visit (1906) stated that the birds were being rapidly killed by the cats. Our visit was too late in the season for us to say if all are gone or not.

In the vicinity of the spring near the cypress grove the party estimated the number of goats at 5,000. Naturally the water hole was in a foul and filthy condition. The animals have increased to a prodigious extent since they were first "planted."[10]

There are two stories told as to the early introduction of this pernicious pest on Guadalupe. One has it that the early whalers sailing from New England "planted" goats on all of the outlying and uninhabited islands in their track in order to provide a supply of fresh meat for their crews without the necessity of visiting a port where risk of desertion was always great. This version may be true, but when Dr. Palmer was on the island in 1875, the animals were there but had not increased sufficiently to cause any damage. In 1885 Green[11] stated there were many thousand.

The other version came to me after I returned to San Francisco. It was related to me by one John McCormick. One of the early whalers, Captain Breen, obtained a concession from the Mexican Government to raise goats on Guadalupe and introduced the nucleus of a herd there in 1872. This concession passed to Captain Breen's son who in turn willed a one-third interest to Felix Franquient and two-thirds to Sammy Solomon. Efforts to confirm this story were unsuccessful. Mr. McCormick told me he had reports that there were several million goats on the island and when informed that our party estimated the number at 40,000 to 60,000 his interest waned!

[10] See figure in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, p. 84, from photograph by J. M. Gallegos.
[11] Bulletin Calif. Acad. Sci., Vol. 1, Aug. 29, 1885, p. 215.

However the goats originally reached Guadalupe, they have increased enormously and through inbreeding have developed into a motley race colored white, red, brown, spotted, blotched, and black; curious malformations of horns have also resulted. They are at perfect ease on the tablelands of the top, on the perpendicular cliffs of the seashore or the steep-walled cavernous cañons. They were not very shy at the time of our visit. Two of them took up a station on the face of a vertical cliff close behind our camp and the ledge on which they had a footing was so narrow they apparently could not turn around to get back the way they went. Their bleating was somewhat annoying at times but finally one of them half jumped, half slid, to a talus slope 50 feet below. A safe landing was made and the goat trotted away as if that was an every-day occurrence. The cowboy propensities of one of our deck hands finally became irresistible and he lassoed the other animal and hauled it down.[12]

Several times we saw goats go deliberately to the sea and drink, and we were satisfied that this was practically the only method the majority of them have of quenching their thirst during the dry season. It is believed that many of them never visit the sources of freshwater on the island.

The party, while on the top of the island, collected a considerable supply of seeds of the Guadalupe cypress, a marvelously beautiful and graceful tree, entirely distinct from all other known cypresses. It is sometimes called "blue cypress" because of the blue-gray color of the foliage. For many years, the species was represented in California only by a few beautiful specimens on the grounds of the state capitol at Sacramento, two smaller ones in Golden Gate Park, San Francisco, and some others in Balboa Park, San Diego. None of these had ever produced seed. Therefore, Mr. John McLaren, Superintendent of Golden Gate Park, was very grateful for the supply of seeds brought back to him. A great many of them grew under the expert attention they received and may be expected to furnish shade to the children of the park long after the last one on Guadalupe has been "barked" and killed by the goats. Those who saw the grove there in 1922 stated that no small

[12] See figure in Nat Geog Mag., Vol. 44, No. 1, p. 82, July, 1923.

trees were found at all. The goats evidently eat every seedling which starts. In addition they had peeled the bark from many of the large trees to a point as high as they could reach.

The presence about the water hole on top of the island of a horse, six mules and 14 burros caused considerable astonishment to the party some of whom would have liked immensely to have received some assistance from these sturdy animals before they succeeded in negotiating the steep descent of the mountain. They reached camp, greatly fatigued, soon after dark.

Mr. Anthony and I rowed south from the landing, six or seven miles in order to make a careful search in the water and on land for fur seals but the quest was fruitless.

We landed at the first large cañon south of the buildings and spent two hours collecting on shore. Signs of house mice showed that these animals were excessively abundant. The rock slides were occupied by numerous Kaeding's petrels. These birds are chiefly nocturnal in their movements on land, and each night at our camp we heard them chattering among the rocks and cañons. Several were attracted to the lights on the ship and were captured easily. They are evidently not as expert on the wing as one would be led to expect by watching the birds gracefully skim the waves of the open sea; Mr. Slevin found two dried carcasses impinged on the thorns of the "cholla" cactus.

On July 14 Messrs. Anthony, Slevin, Terron, Barnhart, Tose and I rowed southward to a large cañon (Esparsa Cañon) which opens to the sea about three miles south of the Northeast Anchorage. The primary object was to secure seeds of the palm trees, about 1,000 of which grew above an elevation of 750 feet at this place. No ripe seeds were found and small trees which could possibly be transplanted were missing. Evidently not a new tree has started for a great many years, another blot against the goats. (See pl. 19, fig. 2.)

We succeeded in collecting a few other species of plants which the goats could not reach. Our method was to scale a cliff as far as possible and then shoot a fragment of the plant from its place of growth. Practically nothing edible for the goats could be reached by us; they are better cliff climbers

than we. Several things indicated that there might be fresh water underground in this cañon or as springs farther up.

The remainder of the party either worked in camp or in that vicinity during the day.

Early on the morning of July 15 Messrs. Terron, Anthony, Slevin, the engineer of the *Tecate* and I went to the top of the pine ridge, a knife-like promontory 2,500 to 4,000 feet high, on the northwest end of the island. We ascended from the first cañon north of the Northeast Anchorage and followed the crest of the ridge southeast about three miles.

Enormous, senile, wide spreading pines were very common on the top; some of them were beautiful specimens but many were dead or dying and a great many more had fallen. When we stopped on our southward march the pines were growing scarcer and the beautiful Guadalupe oak had appeared in considerable numbers.

Both of these trees are peculiar to Guadalupe and it is said there is not a living specimen of the oak elsewhere and very few pines. We were very anxious to secure acorns but systematic search failed to reveal a single one. We even climbed numerous trees in hopes of finding one lodged in a crotch or cavity but this failed. One botanist has stated that the acorns of this oak are the largest in existence so we were greatly disappointed in our failure.

With the pines we were more successful and a large supply of cones was brought back. As with the cypresses and palms, the goats have for many years effectually prevented any new growth and if some one does not succeed in transplanting the oak this beautiful species in a few more years will be forever lost.

The top of this ridge and a considerable distance down on the seaward side is bathed in almost constant fog. It was only between banks of this that we were able to get a glimpse, now and then, of the country round about and to take some pictures. The trees condense a great deal of moisture from these clouds and underneath many of them the ground was very moist.

Sr. Cuesta-Terron suggested that if Guadalupe could be made a government reservation it should be possible to fence

certain favorable forested areas of all the species of trees and thus keep the goats out. If this admirable idea can be carried out it no doubt will serve to perpetuate in their native habitat the five species which are otherwise doomed to certain extinction when the present generation of individuals is gone. These are the oak, pine, palm, cypress, and cedar.

We found none of the beautiful undergrowth of shrubs and succulent plants of this forest which was so fascinating to Dr. Palmer 50 years before. It is believed that about 100 native, endemic species of plants may have been entirely exterminated by the goats in this time.

We were greatly disappointed at finding no flickers, wrens or towhees. The dusky kinglet was also not seen although it had previously been found in the trees we visited. We did see about 15 individuals of the red-breasted nuthatch and many Guadalupe juncos. Guadalupe rock wrens and Guadalupe house finches were very abundant. Apparently these species had completed the rearing of young for the year and no eggs were found. Three red-tailed hawks were seen; this species is common on the island and was seen almost every day. A great blue heron was seen on shore.

Messrs. Tose and Hinkley worked closer to camp during the day and after the pine ridge party had returned the shore camp was broken and all hands went on board the *Tecate* for the night. Mr. Barnhart had spent the day studying the fishes about the shores near camp. Our facilities did not permit the preservation of an extensive collection of this interesting group, a fact which we regretted whenever we saw the intense blue *Azurina hirundo* over the kelp gardens. Mr. Anthony had helped to collect the type and two other specimens of this beautiful fish 25 years previously and they still remain the sole museum records of the species. We saw considerable numbers of them, but never many at one time; they persistently refused to take any bait we had to offer.

One of the most striking features of Guadalupe was the very unusual tameness of some of the birds. Rock wrens[13] were at almost every landing and juncos and finches were abundant among the trees. (See pl. 17, fig. 2.) All three species were most confiding and fearless in their behavior. If we sat down

[13] See figure in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, p. 73.

to eat a lunch and remained motionless for a few minutes, one or more of them would alight on our boots or hats. The strange part of it is that the cats have not as yet exterminated these species as well as some others.

This habit was in great contrast to all species on Cedros Island visited a few days later. There the birds, all species, were so wild and wary that it was almost impossible to collect specimens. I know of no explanation of these facts. Human beings visit one island as often as the other and probably never have the small birds been molested in either place other than by collectors.

The next morning, July 16, at eight o'clock, the ship got under way and sailed around the north end again to the elephant seal beach. The shore and caves were examined closely by rowing along just outside the surf line; we had high hopes of being as fortunate in our location of fur seals as we had been with elephant seals but there was no sign of the objects of our search on this end of the island. At the last cave before reaching the elephant seal beach there were 22 elephant seals hauled on a small sand bank and 14 just outside in the water. There appeared to be more of the animals on the rookery beach than on the day we made the count but we did not stop to check the earlier figures.

Cruising on down the west side of the island slowly we examined minutely every nook and corner where it appeared at all likely fur seals might be. At one p. m. we anchored off Jack's Bay, halfway down the island and went ashore to examine the ancient fur-seal rookery ground. Here was located originally a rookery with as many animals on it as any of the largest breeding grounds of the Pribilof Islands.

The boundaries of the great rookery could be traced almost exactly by the smooth and polished rocks which had been worn this way by the trampling of thousands upon thousands of flippers for many, many years. At the western end of the rookery there was the outline of the hauling ground for the adolescent males, the bachelors, extending far back of the beach line. And back of it there was a cañon with a causeway, fenced off with built-up rocks and logs of the native palm tree. The latter were thoroughly decayed showing that a great many years

had elapsed since they were put in place. At the upper end of the causeway on a little tableland was a corral, partially demolished.

The rookery proper occupied a fringe on a boulder beach about half a mile long lying east of the hauling ground. In front, and awash during the highest waves, there is a rough and jagged lava reef. The tide pools of this undoubtedly furnished admirable places for the young pups to learn to swim. At the eastern end of the rookery was what appeared to be the killing ground and a flat smooth area for pegging out the skins to dry. In the early days of fur-seal work this method of curing was employed instead of the use of salt which has been used now for about 75 years. At the eastern end of the rookery were the rock walls of eight houses. No framework was left. They were probably covered with the skins of the elephant seals.

We could not walk over this deserted ground without forming a picture of the grand sight it must have been when the first visitors built their rude huts and began the relentless slaughter of the fur-seal herd. Those who are familiar with the history of the Alaska fur-seal herd know what a waste there has been. It is recorded that the killing was done by Aleutian islanders brought down by the intrepid Yankee sailors for the purpose. The Aleutians were under the domination of Russia at that time and the Americans were able to arrange to do the work on shares; they were navigators, the Russians were not. It appears that parties of the Alaskan natives were landed with water at the rookery grounds and there left to make the season's catch. After the work was done the ship returned for them and took them away again. Evidently the greatest need was for water and a well had been dug near the buildings. It had caved in badly and showed no sign of moisture of any kind in the bottom.

It was here at Jack's Bay that Dr. Charles H. Townsend collected four fragmentary skulls of fur seals in 1888. They were found to represent a species decidedly distinct from the Alaska fur seal; in fact they were more closely related to those that live in the Antarctic regions than to those of the Arctic. The Guadalupe species was named *Arctocephalus townsendi* by

Dr. Merriam, and the four skulls in the original collection form the sole representation of the species in the world. Although many people have searched for the species since, it appears to be extinct.

In going over the rookery ground we had expectations of finding bones but were disappointed. It appears that in this desert air bones disintegrate very rapidly and fall to a powder. Even some bones of goats were almost completely destroyed and they could not have been there longer ago than about 1880. The great fur-seal rookeries were exploited chiefly between the years 1800 and 1810.

Here at Jack's Bay Messrs. Slevin and Tose collected various and sundry species of insects and shells and succeeded in getting one house mouse. This is a dry, barren part of the island and the mice have lived here for many generations, without water the greater part of the time, yet they do not appear to differ from this pest elsewhere.

I here succeeded in finding in the rock pools a few individuals of the marine shell *Uvanilla regina* Stearns, a beautiful species originally found on Guadalupe and not certainly known elsewhere.

That afternoon we sailed slowly down the remainder of the west side of the island but finding nothing of importance we anchored in the bight known as "South Anchorage" for the night.

Two fair-sized islets at the south end of Guadalupe known as Inner and Outer islands were examined minutely for fur seals but none was found. On a shelf of Inner Island we saw 14 California sea lions sleeping quietly in their solitude.

These islands are very interesting geologically. One is built of lava, like most of Guadalupe, and is a crater, bowl-shaped on the inside. The sea has eaten into the rocks so that a perpendicular wall is left all around. Next day from an elevation on Guadalupe we could see water inside the crater, but whether it was fresh or salt could not be determined. The other island rises out of the water, a sheer monolith with perpendicular walls going down into deep water. This one was composed of a light brown massive rock very decidedly different from the stratified lava of which the crater is built.

In the early morning of July 17 Messrs. Anthony, Tose, Hinkley, Barnhart and I went over the reef ground near South Anchorage, this being an excellent hauling place for fur seals should any be around, but not a sign of an animal was found.

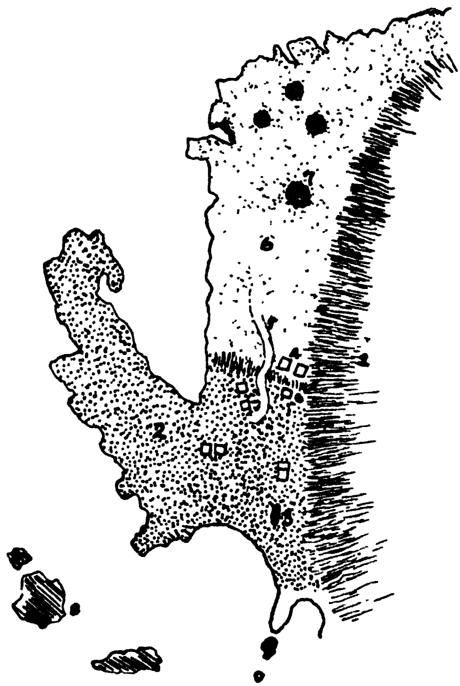

Fig. 2. Sketch of South Rookery, an abandoned fur seal breeding ground on Guadalupe Island.—1, Steep escarpment leading to high land above. —2, Main rookery ground, excessively rough with blocks and boulders of lava; many worn smooth and polished from trampling of the fur seals.—3, A wrecked dory.—4, Squares represent walls of human habitations.—5, Trail leading to smooth tableland about 50 feet above level of rookery.—6, Smooth sandy area used for pegging out seal skins to dry.—7, Round, flat topped piles of stones, presumably used for platforms for piling skins.

At one time this area was occupied by a vast rookery of Guadalupe fur seals. As at Jack's Bay the boundaries were plainly traceable by the flipper-polished rocks. The rookery occupied a stretch of coastline at least three-fourths of a mile long, the rocks being greatly worn; evidently the ground was occupied for a very long period of time and if this feature be a safe means of estimating the age of a rookery, then Guada-

lupe was inhabited much before the Pribilof Islands by the herds there.

On top of a tableland was a smoothed-off area used as a pegging-out ground, in many cases the pegs were still present but grealy worn by the wind blown sand. Piles of boulders, carefully arranged in circles may have been used as a place to put the fresh skins before pegging to keep them clean and free of sand; no other use could be thought of to which they might have been put. (See pl. 15, fig. 2.)

Near the beach line there were the remains of the stone walls of nine houses, similar in every way to those previously seen at Jack's Bay. (See pl. 17, fig. 1.)

The country at this end of the island is an exceedingly barren desert, where even the goats find difficulty in maintaining an existence. The uplands were very rough and rugged with strewn lava and in one patch of this a little cactus belonging to the genus Mammillaria was collected. Until then the only other form of this group found was the "cholla."

Under some vegetation near the beach Mr. Slevin and I collected two species of Hemiptera and two beetles we had not previously found on the island.

In the afternoon we continued slowly with the ship up the eastern side of the island, examining the shores very carefully for fur seals. About two miles north of the south end of the island we found more ancient rookery ground, the occupied area being only about one-half mile long, but near by were the remains of 19 houses. Evidently this was the most favorably located of the rookeries for human habitation although we could see little reason for choice in the matter. Probably the workmen here walked across to the other rookeries for sealing work.

Of course we were much disappointed at finding no living fur seals. It would seem that if the last hunters had left any breeding animals at all, they would have increased sufficiently by now to have been seen under the close scrutiny we gave the shores. The absence of bones on the old killing fields and rookeries also disappointed us because we had hoped to be able to add at least some portions of skeletons to the collections.

After we had cruised northward along the eastern shore to the point where we left off with the rowboat a few days before,

the ship was headed for San Quintin Bay on the peninsula of Lower California.

This we reached at two p. m. of July 18 and Messrs. Anthony, Tose, Slevin, Barnhart and I went ashore to collect on the west side of the bay.

Miscellaneous specimens of various kinds were taken, among which were a rattlesnake and a lizard, found by Mr. Slevin. These pleased him very much because up to this time he had not gotten anything for the Department of Herpetology. He had been unable to verify the vague reports of the lizard on Guadalupe.[14]

The remainder of our party went ashore on the east side of the bay at the village to arrange for the use of an automobile the following day.

The next morning, July 19, Messrs. Angulo, Cuesta-Terron, Anthony, Slevin and I secured a light automobile in the village of San Quintin for use during the day. Mr. Green, the postmaster, owned the machine and we drove northeastward about 15 miles, diagonally across a level plain, then over gently rolling hills to the mouth of a cañon which comes out of higher mountainous country to the eastward. At the mouth of the cañon there is a huge land-mark in the form of a red rock escarpment and near by a well kept farm has the name "Red Rock Ranch." We were treated to huge figs, four inches long, delicious watermelons and tomatoes, all irrigated with water from the stream in the cañon.

From the ranch we drove up this stream about three miles to the Mission of Santo Domingo, once a populous and important station on the line of civilized habitations from the capital of Lower and Upper California, Loreto, to San Francisco. Now a few natives were left and they seemed to be fairly prosperous, with well kept farms and houses. Conspicuous among the buildings was a schoolhouse which would be a credit to many small communities in the United States. The "dobe" walls of the mission yard were mostly in ruins but one of the buildings was still well kept and was used regularly for church services.

[14] See Green, Bulletin Calif. Acad. Sci., Vol. 1, 1885, p. 220, who reported having seen "two or three small lizards." Mr. Slevin thinks that if a species of lizard did once live on the island it is probable that the cats have destroyed them all by now.

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Collecting in this vicinity was not particularly encouraging so we returned early to the plains where a few antelope ground squirrels were taken as they rested, bird fashion, in the tops of the sage brush. Also just before dusk Captain Angulo and others derived considerable pleasure in securing some jack rabbits for us for specimens. I had missed an easy rifle shot at a coyote early in the afternoon and it took me some time to recover.

The village of San Quintin consisted of a few miscellaneous houses, the most conspicuous of which was the old "Company House." Many years before, this had been the scene of considerable activity by a "colonization" company but it did not turn out well. Mr. Anthony had been with the company as a surveyor and had collected many valuable specimens of birds in this vicinity. The place was also interesting to those of us from the California Academy of Sciences because our Secretary, Mr. W. W. Sargeant, had also been on hand with the first contingent of "settlers."

While we were working on the east side of the bay, Messrs. Gallegos, Tose, Hinkley and Barnhart collected on the west side and secured many valuable specimens.

On July 20, Messrs. Anthony, Gallegos, Slevin, Barnhart and Tose worked on the west side of the bay adding many more specimens to our rapidly growing collection.

I found it profitable to visit some low cliffs, not over 20 feet high, on the east side of the bay and just south of the village. Here I succeeded in getting a very large collection of fossil shells consisting of several thousand specimens.

The geology in the vicinity of San Quintin is comparatively simple. In late Pleistocene the present bay was a broad indentation of the sea and ocean-living species were very abundant. Subsequent elevation raised the bottom on the east side in a broad fold. The preservation of the fossil shells is excellent, many of them retaining some of the original coloration. How far back toward the foothills this embayment extended cannot be determined but probably it went to the first terrace, the beginning of a long series of rolling hills or mesa. This terrace is said also to contain fossils but none were secured. It is probably much older than the outcrops on the bay. The moun-

tainous country to the east of this terrace is metamorphic, the age not having been determined.

On the west side of the bay there is a chain of low volcanic cones not over 300 feet high. Lava has spread outward from these as far as the bay shore and on top of a broad shelf of this there are other Pleistocene marine sediments but with a different set of fossils. Among those collected were some huge Schizotherous clams, fully eight inches long.

The broad plain east of the bay was once occupied by great numbers of deer and antelope but they have almost disappeared on account of the activities of "sportsmen" from further north, and hunters employed by mining companies to provide fresh meat for their camps.

On July 21 we completed our work at San Quintin Bay. Messrs. Anthony, Slevin, Tose, Gallegos, Hinkley and I all worked at collecting on the west side. A few insects were found but no species was abundant. Coyotes, wood rats, and rabbits were abundant, as well as several species of desert field mice. One of the rarities collected was a very small species of shrew. Birds were very scarce about the bush-covered hills, Bell's sparrow being the dominant form. Mr. Slevin succeeding in securing eight rattlesnakes for the collection, a few of them being taken by other members of the party. There is no question but experience in this as in other lines makes for efficiency. He seemed to know just which brush thickets to explore and with his little .22 caliber shot pistol he captured three other species of snakes as well as a large number of lizards belonging to five or more species.

Three species of land snails were very common among the brush thickets on the west side, the most noticeable one being the large *Micrarionta stearnsiana* here about to the southern extremity of its range.

We left the bay at four p. m. and slowly made our way out through the tortuous channel at the entrance. This is so difficult to follow that it would be dangerous for a boat much larger than the *Tecate* or for a navigator unfamiliar with the water.

During the night Mr. Barnhart took water and plankton samples at regular intervals on the way to Cedros Island. I

relieved him at five a. m. At one place a peculiar temperature condition was found; this dropped about five degrees in a distance of eight miles and rose suddenly on the opposite side. This was interpreted to mean a submarine obstruction to the free flow of currents and a consequent "up-welling" of the colder waters from below.

At eight a. m. of July 22 we were in sight of Cedros Island and the east shore was followed southward. The sea was without a ripple and as we cruised close in shore we were able to note some of the interesting features of this remarkable island. Near the north end we passed the site of a copper and gold mine, abandoned long ago. It was visited later and notes were made of surroundings.

Nearly every slightly elevated rocky pinnacle or promontory along the shore was occupied by a pair of ospreys with their nest. In some of these young birds could be seen, almost as large as their parents.

About halfway between the north end and the Grand Cañon in the center of the island, a crosswise fault extends northwest. On the south side of this break what appeared to be Tertiary sediments had been elevated about 200 feet above the sea. This deposit extends southward about two miles and is lost beneath the sea due to another fault. This elevation is entirely distinct from another which has lifted the greater part of the east side of the island out of the water about 20 feet. The old beach line was plainly seen from the ship.

At noon we landed near the south end of the island where Bernstein Brothers of San Quintin and San Diego have an abalone packing plant. They have two outlying collecting camps with two divers each and enough of these fine mollusks are obtained to keep 14 shore men employed.

The plant consisted of boiler, cooking vats, and wire drying frames. Canning machinery and a dock were in course of installation. They had a large launch which made regular runs to San Diego and two smaller ones to attend the collecting camps.

The abalones were brought in in the shell and consisted chiefly of the species, *Haliotus corrugata.* The meats were cooked three times in boiling water at intervals of a week or

two. Between times they were dried in the sun on the wire netting, the entire process taking about six weeks.

The meat when dry is hard as a piece of untanned leather and is brown in color but it has a very agreeable flavor. The product is shipped to China and Hawaii, some of the shells going elsewhere to various markets. It was stated by the Superintendent, Mr. Charles Bernstein, that five tons of fresh meat made one ton dried.

In the afternoon all of the party went ashore for collecting. Most of us followed the pipe line inland about two miles and thence another mile to a large spring. Here a permanent supply of very good water is had. At the source a very considerable area is grown up with rank water vegetation and no doubt the accumulation of this through years has retarded the flow of water somewhat. If it were cleaned out probably a sufficient supply could be had for much greater industrial needs or even a limited amount of irrigation.

Tracks of deer and goats were abundant about the spring and a few small trees cast a most welcome shade. Birds were excessively scarce and so wild as to be almost unobtainable. Some rather interesting insects were found, among others being a huge dragonfly four inches long. Numerous land shells peculiar to Cedros Island were picked from certain desert plants. They were hibernating in closely-sealed shells. In the spring, large numbers of a minute freshwater gastropod were found, probably belonging to the genus Paludestrina. Also there and in the stream leading to the pipe line entrance, Mr. Slevin collected numerous specimens of a small frog.

Here we made our first acquaintance with that strange monstrosity, the elephant tree of Cedros. It grows very close to the ground, the highest being not more than about 12 feet tall. At the base many of them were fully two feet in diameter and the thick club-shaped limbs taper rapidly to nothing. The trees had shed their leaves but were in full bloom, each one a gorgeous mass of beautiful pink.

We made a much more extended stay on Cedros on our return and detailed observations will be left until we come to that. But that evening Mr. Anthony and I put out many traps hoping to catch a very small pocket gopher which I saw during

the afternoon. Our attempt was futile, but we did capture a lizard in our trap which Mr. Slevin stated had not previously been taken on Cedros. Strange to say, he did not get another specimen.

At seven a. m. of July 23 we sailed for Magdalena Bay, far to the southward. Between Natividad Island and the peninsula great numbers of cormorants were flying from east to west in long flocks. For half an hour they passed at a rate conservatively estimated at 100 per minute.

Many petrels and shearwaters were seen but no albatrosses cared to follow us south of Cedros Island. During the day we sailed for hours through loose flocks of red phalaropes. They were evidently southward bound but found time to engage busily in catching minute animal life from the surface of the sea for food.

On July 24 we had four hours' delay out at sea due to engine trouble, but our engineer seemed to be able to apply the proper remedy and we continued later to Magdalena Bay, arriving after nightfall. During our stop at sea a collection of surface dwelling organisms was secured with a dip net. Among the interesting forms thus secured were several larval fishes; among them we were able to identify pipe fishes, flying fishes, and the bonito or skipjack of the mackerel family. Some of these were barely out of the egg and they offer a possible clue to the breeding area of the tuna for which the naturalists of the U. S. S. *Albatross* searched in vain for several years.

We passed Cape San Lazaro as the sun settled behind a bank of clouds on the western horizon leaving the brilliantly shining stars to light a tranquil sea. The atmosphere, the water, everything about us told us in unmistakable terms that we were approaching the tropics.

As we entered the bay we passed close to Sail Rock, a target for the U. S. Navy in other days, and at nine-thirty p. m. we anchored in front of the village of Magdalena.

During the trip down from Cedros Island whales were sighted only twice. The scarcity of these cetaceans was a surprise because it was in these waters that much of the pelagic whale industry was concentrated during the early part of the 19th century.

Swordfish and tuna were common on the way down and we caught a few bonito and skipjack on the gig. Some of the bonito contained ripe eggs indicating that the spawning season was at hand.

Man-o-war birds, Heermann's gulls, elegant terns and brown pelicans came to meet us when we were about 15 miles out from the bay. In the late evening red phalaropes settled abundantly on the water; some of them still retained the red plumage of the breeding season. A black-footed albatross sailed past us in the afternoon and after one look departed in disgust. Least, Soccoro, black and Kaeding's petrels were common all day, their lazy but tireless flight often being the only sign of life on a glassy sea.

In the morning of July 25 Messrs. Tose and Hinkley went south from the village along the bay shore and by noon had collected about 20 birds.

Mr. Anthony and I went north to a mangrove swamp where four hours were spent in the almost impenetrable tangle, often up to the waist in mud and water. In this we succeeded in securing three specimens of the rare mangrove warbler but did not get one of the rails which we could hear from time to time. It is said that these birds blend into their surroundings so perfectly that it is only by long experience that the collector is able to secure them with regularity.

Mr. Slevin worked north of the village and took about 70 lizards and two snakes.

Magdalena Bay is so large that the eastern shore cannot be seen from the village on the west side. North and south there is inland water for about 100 miles, much of it shoal but the anchoring ground is large and safe. There are a great many sand and mud flats and lagoons lined with mangroves and coarse grasses. In these lagoons there were formerly great numbers of turtles and their bones and shells still line the beaches. California gray whales used to visit the lagoons but the species now appears virtually extinct. Porpoises, however, were often seen in the bay waters.

The village of Magdalena consists of several frame houses and concrete warehouses. It was established as a concession granted to a colonization company, not now in existence. The

chief source of revenue was the lichen called "Orchilla." This grows luxuriantly on cactus and other desert plants of the region and was shipped to Germany for use in dye manufacture until chemists working with coal tar derivatives obtained better colors. Boats seldom call at the village any more. A company of marines located here had just completed the erection of a radio station.

Water has to be brought by boat from the east side of the bay, there being none near where the village is located. The important commodity sells for 50 cents per barrel.

On July 26 Mr. Anthony and I again visited the mangrove swamp and succeeded in securing seven more mangrove warblers. Also three Xantus' jays were taken; this is likewise a rare species in ornithological collections. I was surprised to find numerous living specimens of a huge Littorina adhering to the semisubmerged roots of the mangrove.

We walked across the sand dunes to the ocean beach to the westward where a considerable number of marine mollusks was collected. This seemed to be a favorite place for the capture of turtles by the people of Magdalena. We counted 65 shells of those recently killed. The sex of at least 40 could be determined and they were all found to be females. It is said the turtles are killed with harpoons as they approach the sand beaches to lay their eggs.

Mr. Slevin continued to add largely to the collection of reptiles, the most important being three specimens of a lizard called "whip-tail." He took four on the previous day; only one had been known previously.

Other members of the party were variously engaged; Sr. Gallegos continued to add to his collection of insects and plants; and Messrs. Tose and Hinkley worked with the birds continuously.

On the morning of July 27 Mr. Anthony brought in all of the traps which had been placed out at this place. Very few specimens of mammals were taken and they were chiefly rats of the genus Neotoma and desert mice belonging to Peromyscus and Perognathus.

I spent the morning collecting fossil shells from a large deposit which is exposed to an elevation of 20 feet above the bay

immediately north of the village a few rods. Here in a soft unconsolidated sand were great numbers of shells, many species being rare in collections. The age of the deposit is Pleistocene and it represents an elevated beach line similar to what has already been described at San Quintin and Cedros Island. Prior to this late elevation the land on which the village stands was an island and Magdalena Bay had a broad entrance to the northward. This permitted free entrance of ocean water and with it ocean-dwelling species of animals. With the elevation of the land the north entrance was closed but the lagoon extending far to the northward inside the belt of seashore sand dunes is a remnant of it. It is said that this lagoon is connected with the sea to the northward thus in fact leaving Magdalena an island at present although it is more like a peninsula. The mountains back of the village are metamorphic and igneous and therefore have been above the sea for a long period of time. During the Pleistocene at least, the range was an island, far removed from other high land, and even now partakes of the characters of an island. Therefore, it would be expected that sedentary animals such as mammals and insects, and also the plants, would have been modified by isolation and have become separate species or subspecies. This appears to be true in many cases.

We left the anchorage at Magdalena at noon of July 27 and went to the village located on Santa Margarita Island 20 miles to the southward. To get there we had to pass through a rather difficult channel, the southern half of the bay being much shallower than the northern.

Santa Margarita Island occupies the same position with reference to Magdalena Bay as the San Francisco Peninsula does to San Francisco Bay. The island has been subjected to the same elevation of Pleistocene sediments around the shore lines as has been described for other places. It is divided into two parts both the northern and southern being mountainous and composed of metamorphic or igneous rocks. The low pass two miles long, north and south, connecting the two parts, is level and on the western side is fringed by a belt of enormous sand dunes. Near the center of the isthmus country there is a zone of sedimentary rocks chiefly thinly bedded but hard sand-

stones. No fossils could be found in them but they had the appearance of being pre-tertiary on account of the alteration which has taken place. The strata dip to the westward about 80° and strike about northeast-southwest.

A great deal of magnesite has been collected about the lower slopes of the mountains of both sections of the island. Comparatively large quantities have been shipped out and some trucks and other machinery were still on hand. It was understood that under the laws of Mexico the concession under which the deposit had been exploited had been automatically cancelled not long before our arrival. The manner of formation of the magnesite is an interesting problem, a solution of which was not evident from my brief study. The mineral seemed to be fairly pure and occurred chiefly as loose chunks or nodules having mammillary structure, as though deposited from mineral springs.

Here at Santa Margarita was a well equipped plant for the manufacture of oil and meal from fish. It was idle at the time but in good condition. Apparently some difficulties had arisen in regard to the collection of the fish for working up. It was said that a small species resembling an anchovy was the chief raw material and no difficulty had been encountered in securing a sufficient supply by the use of a 200-foot seine on the neighboring beaches. By this method many other species were secured; particularly abundant were several species of sharks.

Near the wharf there was a building which had been put up for use as a turtle cannery. It had a concrete floor and was used as a habitation at the time of our visit. Much of the machinery was still in place. We were informed that the original concession had been granted many years previously to a man named O. Sandaval but no attempt at operation had been made for 15 or more years.

The ship was tied up to the dock here and most of us went ashore. Mr. Anthony and I put out some traps and collected a few desirable birds. We also found a snake (a black racer) which Mr. Slevin considered very desirable. I found many excellent specimens of a species of land shell (Bulimulus) related to a form which lives in the Cape Region farther south

on the peninsula. Mr. Hinkley secured a specimen of the endemic and greatly desired jack rabbit. Mr. Slevin secured all previously recorded species of reptiles except a rattlesnake.

This seemed like a very excellent collecting station and we regretted that we could not spend a week or a month in the vicinity. Across the bay to the eastward the great and intricate mangrove swamps and islands invite the naturalist most enticingly. Mr. Barnhart found a strange water temperature condition in Magdalena Bay. Where we anchored at Magdalena it was 64°F. Farther out and closer to the entrance it was 68°. Outside it was 74° and at Margarita it was 71°. Why is the water so cold in the north part of the bay? We could not suggest an answer.

On the morning of July 28 we found only four mammals in the traps, two wood rats and two mice (Perognathus). I shot two bats near the wharf in the early morning light as they were flying along a low cliff near the fertilizer plant.

Mr. Slevin and I walked south into the mountains of the south half of the island, thence to the "ranch" on the west side of the isthmus, and back through the mountains of the north half. Numerous interesting birds were taken some of which belong to the fauna of the Cape Region. This appears to be the extreme northern limit of distribution of this remarkable fauna. Woodpeckers and cardinals, peculiar to the region south were especially attractive. The former make their nesting holes in the trunks of the giant cactus. The cardinal's song did not appear to differ from that of the familiar bird of the middle west although this one is a different species.

Among the reptiles collected there were several specimens of a desert iguana which is an excessively rapid runner. In action the tail is folded upward, the front legs placed close beside the body and the hind legs only are used.

Messrs. Anthony, Tose and Hinkley secured some more desirable birds and another jack rabbit. Insects were very scarce but we secured a few species.

The climate at Magdalena is very uniform throughout the year. The nights are cool, the days hot. A breeze usually blows on the water in the afternoon but inland that part of the day is uncomfortably warm. Rain seldom falls, sometimes

only at intervals of years. Far to the eastward over the Gulf of California, black clouds with flashes of lightning were plainly visible at night.

At the so-called "ranch" one family lived in a shed with brush roof, no walls, doors or stove. They had a small patch cleared of brush where watermelons, tomatoes, and date palms were growing with practically no attention. Water was available at about 15 feet depth and was used for household purposes but we found it to be too salty to satisfy our thirsts. The ranch is in a valley of about 10 square miles densely grown with brush, small trees and giant cactus. Undoubtedly there is fairly fresh water at a moderate depth over the entire area. It would seem that farming could be more extensively prosecuted if there was a market for the product.

July 29 proved to be an excellent day for collecting. Messrs. Cuesta-Terron, Slevin, Gallegos, Tose, Barnhart, Hinkley, Anthony, Captain Angulo and I went across the isthmus to the ranch, the Captain being the pilot of one of the auto trucks left behind by the magnesite company. He proved his ability as a navigator on land as well as on the sea.

Considerable time was spent in the giant cactus forest where we found ripe fruit as large as a medium sized orange and with a flavor similar to a raspberry. They were delicious eating and were very effective in allaying the thirst the uninitiated always experiences in a hot desert afternoon.

Many birds were found in this forest, the most important for us being the Cape Region species. The woodpeckers were evidently very fond of the cactus fruit and many ospreys had selected these strange trees for nesting sites. Some of the bulky structures had become so heavy through years of additions that the trees had collapsed.[15]

The rank desert vegetation of the vicinity of the "ranch" enabled us to secure some attractive insects, and two species of land shells (Bulimulus and Micrarionta) were common. Mr. Slevin made very important additions to the reptile collection, one being a rattlesnake not previously known from this island.

Another specimen of the jack rabbit was taken, this making

[15] See figures in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, pp. 90, 91.

the third for our party, and the Mexican naturalists have taken one.

On the morning of July 30 we ran the line of traps at the first break of day in hopes of getting to our specimens before the ants, but we were unsuccessful. The voracious insects had completely spoiled several otherwise valuable specimens; all we could do was to preserve them in alcohol. The ants are nocturnal in most of the places in which we have trapped this season and an animal is no sooner caught than it is attacked. In spite of this difficulty Santa Margarita Island furnished us with several specimens of very rare desert mice.

It was with reluctance that we left this anchorage at nine a. m. and started northward on the journey back to San Diego.

At one p. m. of July 31 we anchored behind the point of land known as Abreojos (eyes open). On the way north we followed the shore sufficiently close so that we would have discovered any herd of elephant seals or other conspicuous animals which might have been hauled out. It was in one of the long bights of this shore line that Dr. C. H. Townsend collected several elephant seals for the National Museum about 1888.

Messrs. Anthony, Gallegos, Slevin, Barnhart and I went ashore for collecting, the landing being made at two shacks used in other seasons by spiny lobster fishermen. Many turtle bones, lobster carcasses and mollusks were drifted upon the beach. I could not help but regret that equipment was not available to dredge the ocean bottom because it was here that Henry Hemphill had made a very extensive collection of shells many years ago. Numerous species taken there by him have not been found elsewhere.

The most conspicuous shells on the beach were the pismo clam. It is prophesied that here will be an important fishery for this mollusk at some future date.

A burro trail with fresh tracks led to the northeast to another lobster camp toward San Ignacio lagoon.

Mr. Anthony stated that the plain back of this point is one of the few remaining ranges of the pronghorn antelope. A fairly fresh horn was picked up near the camp, so the species is probably not yet exterminated.

No land snails could be found in the limited time devoted to the search.

An examination was made of the geological structure outcropping on the shore at the first point northeast of the usual anchorage. Here for about 1000 feet there was an exposure of hard sandstone and shale, dipping southwest at an angle of about 15°. Above, and unconformably upon that series is an even greater thickness of heavy conglomerate which weathers slowly and forms rocky projecting reefs upon which grow the great kelp gardens of the point. Above the conglomerate late Pleistocene sediments rest with great angular unconformity. The shells, however, were not well preserved. Fishes were exceedingly abundant about the point.

We arrived at Asuncion Island on August 1 at eleven a. m. and the anchor had scarcely been dropped when some one of the crew caught a "jewfish" weighing about 150 pounds. Later one was taken which weighed nearly 400 pounds. Several bonito were taken on the troll before we arrived.

Most of the party went ashore soon after arrival. Messrs. Anthony, Cuesta-Terron and I examined all shores carefully for fur seals but found none. At the same time I estimated each group of California sea lions as we passed. The figures of course were hurriedly arrived at but the total, males, females and young, was close to 4000 animals.[16] To this, as an integral part of this rookery, should be added about 1000, subsequently found on Angulo Rock near by. All of the beaches were lined with the animals and they kept up an incessant roar with their barking. Harems seemed to contain from 15 to 18 cows and the young pups were learning to swim in the tide pools. Many of the bulls were badly scarred from fighting, a condition which would largely disappear if some of the surplus males could be eliminated.

This species was found to be very abundant on most of the favorable breeding grounds south of the Mexican Boundary. There are likewise large rookeries off the coast of California. Certainly the species has sufficiently recovered from its early persecution for the surplus males to be taken for commercial purposes. The skins are large, uniform in thickness, and make

[16] See figures in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, pp. 85, 86.

excellent leather. The fat and flesh make an oil and animal meal of a quality which is equal to, or better than, the average derived from whales.

The manner in which the commercialization of such a species can be undertaken without exposing it to unlimited slaughter is a problem difficult indeed to solve. Permits or concessions might be granted to private parties by Mexico and California, limiting the catch to males only and the number to be specified by proper authorities after investigation. While this method of operation looks practicable at first glance it apparently never works out to any other conclusion than the commercial extermination of the species concerned. It has been tried repeatedly in many different countries and has always failed to perpetuate the species in the same abundance with which the work was started.

Another plan of operation, often suggested and tried is to permit unrestricted slaughter by all persons during an open season. This likewise almost always fails in the perpetuation of a marine species in its original abundance and there are few successes with land animals. The reason is not hard to find. When such slaughter begins large catches are made with ease but as more people engage in the enterprise and the number of individuals of the species hunted becomes smaller, increased efforts must be expended to get a profitable catch. These efforts are of two classes; (1) political activity such as the securing of longer open seasons, and fewer restrictions, bribing of enforcement officials, etc.; and (2) increased efficiency of hunters.

One of the most difficult of all classes of beneficial legislation to secure is a measure to more adequately conserve or perpetuate a wild species which is being commercially exploited. Practically never are commercial interests willing to submit to protective restrictions until the species with which they are concerned is approaching industrial extinction.

Therefore, the time to provide and apply protective measures is when the species is still abundant and not exploited.

In the case of the California sea lions I think absolute prohibition of any slaughter whatsoever should be maintained by Mexico in its territorial limits as well as on the high seas.

The same should be done by California and the United States. While this is in force a treaty should be made between the two countries whereby no killing would ever be permitted except on land and by duly authorized agents of the respective governments.

In this manner the Fish and Game Commissions of the two countries could develop a market for the amount of surplus available and for that only. Revenues of course would pass to the governments.

Objection to this method of operation is possible because it may suggest certain doctrines of socialism, but it has been tried and found successful, whereas no other method ever has succeeded in conserving a species of marine mammal.

On Asuncion Island Mr. Slevin took 30 specimens of one species of lizard; no others appear to live there. Land shells were scarce and semifossilized; no live ones were found. Insects also were very rare but we succeeded in finding six species.

The island is a vast roosting place for birds, but few species breed. Brandt's cormorant is the most abundant of the latter and these form black, close, compact "islands" on the level stretches of white sand. Each mass contains a thousand or more birds. This close association seems to be for the purpose of protection from the gulls because, ordinarily, these did not molest the shags at all. But if we disturbed the "island" colony at all, causing the parents to desert young or eggs, the gulls flocked down in great numbers, breaking eggs and killing young indiscriminately. After we learned this we endeavored to cause as little disturbance in the island routine as possible.

The Brandt's cormorant builds its nest of marine algæ and the structures are low and filthy. The Farallon cormorant, which is common on the higher land, builds its nest of sticks and lines it with quill feathers. Some of the nests were built in the low trampled bushes of the island; others were placed in the open and raised to a height of three feet.[17]

A few pairs of brown pelicans nest on the island, but it is chiefly a roosting place for hundreds of thousands of these birds.

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[17] See figures in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, pp. 92, 93.

The western gull nests in small numbers and there were burrows of Cassin's auklet or some shearwater everywhere where there was soil. These holes were unoccupied.

Both species of cormorants and the pelicans had fairly fresh eggs, newly hatched young and young ready to fly, so the nesting season must be greatly prolonged.

Frazer's oystercatchers and black turnstones were fairly common and in the late evening a few Heermann's gulls flew in.

The vicinity of Asuncion Island is wonderfully rich in marine life. A huge jelly fish, vivid magenta in color, and with streamers 20 feet long was abundant. South of the island 20 miles there was a sudden lowering of the temperature of the sea water to 61° F., 13° colder than outside Magdalena Bay. The cold water probably accounts for the abundance of sea life, at least in part.

A short distance northwest of Asuncion Island there is a flat-topped rock 50 feet high on which we collected eight species of beetles in less than an hour. The rock is very conspicuous as the island is approached from the south. Because of the different species of insects from those found on Asuncion, a name for this rock is needed and we proposed to honor it with the name of our congenial captain, Victor Angulo.

Geologically, Asuncion Island is composed almost entirely of Jurassic Franciscan Chert, or a chert which is very similar to this widespread and well known formation in California. On the north side there appeared to be some metamorphism. The island, like so many other places in the region, has been subjected to a comparatively recent short submergence and subsequent elevation to about 25 feet.

Traps were put out in the evening and next morning they contained 14 specimens of Peromyscus.

On August 2 we left Asuncion Island at six a. m. and went ashore on San Roque Island at seven-thirty a. m. It is similar in almost every way to Asuncion but is only about 65 feet high. The steamer *San Jose* went on the rocks here in 1921 and there was a great deal of wreckage strewn about. The hull was firmly wedged between the rocks.

September 5, 1925

Brandt's cormorants were found in enormous numbers but the only nests of the Farallon species were around the shores on piles of driftwood. About 1,000 Heermann's gulls were perched on one rock; very few young were among them.

Several hair seals were seen in the water in the bight on the south side of the island but all efforts to secure specimens failed. Field mice were abundant but we took none during our short stay. No land shells were found and only three species of beetles were taken.

We left San Roque at eleven a. m. and anchored in the north end of San Bartolome (Turtle) Bay at six p. m. Messrs. Anthony, Tose, Slevin and I went ashore with a lantern after dark. Traps were put out and in a bunch of sagebrush we found a rattlesnake which Mr. Slevin promptly shot.

The low sea cliff at the landing consisted of sandstones dipping to the westward. Several species of fossils were collected which later showed the age of the rocks to be Pliocene.

Two Peromyscus were found in the traps next morning (August 3) and we left San Bartolome Bay at six-thirty a. m. It was an exceedingly attractive place to work but our mission was insular and we could not stay.

At nine a. m. we went ashore on the south end of Natividad Island, where the entire party worked all day.

This is another bird island *par excellence*. Gulls, shearwaters and cormorants nest on the highest parts. Many pelicans were seen resting but none seemed to nest. The Brandt's cormorants form "islands" on the level stretches near shore, while the Farallon species goes to the higher interior and builds nests as on Asuncion Island.

Of land birds we saw only desert sparrows, ravens and duck hawks. The latter nest on the island in very accessible places; a person could walk directly to some of the nests.

The island is tunneled with the burrows of black-vented shearwaters. About 40 of these burrows were excavated and five birds were thus secured. One was a young of the year, the others adult. Apparently the birds continued to visit their burrows long after the nesting work was done. About eight species of insects were secured. Dead land shells (Micrarionta)

were everywhere in abundance but not a live one could be found. Mr. Slevin took two species of lizards.

Geologically the island is very old. Shales and sandstones inclined from 0° to 75°, extend from the south end northward at least four miles. No fossils were found and the age was not definitely determinable but the sediments are certainly older than Tertiary. The island has been subjected to a recent submergence down to at least 100 feet. It was then elevated before any considerable quantity of sediment could accumulate.

Six species of cactus were seen, the most conspicuous being the long shafts of the group commonly called giant cactus. Shrubbery was very scarce but there was abundant evidence to show that when there is rain a quick and luxuriant growth of succulent plants follows quickly. All were dead and parched when we were there.

On August 4 the traps on Natividad Island were found to contain 11 Peromyscus. Many of the traps had been sprung by ravens and gulls. Those most successful were set about some bushes which contained very filthy cormorants' nests; there were numerous mouse-burrows under the nests. Some specimens were also taken in the traps set in shearwater burrows, these seemingly forming a haven for mice and lizards as well as birds.

We left Natividad Island soon after daylight and arrived again at Bernstein's abalone plant on Cedros Island at nine a. m. Everyone was glad to get ashore here for various reasons, chiefly because of the abundance of freshwater. The party divided in various directions.

Mr. Slevin and I visited the spring from which the water supply is derived and secured more detailed observations on this little oasis. It is situated on the crest of a ridge between 2,000 and 3,000 feet high and an area of two or three acres is overgrown with rank vegetation. Cedar trees and elephant trees grow around the margin and some of the grass is 10 feet high. Many strange plants and insects were collected. Birds were not common and were excessively wild. Where the water first flows out it is delicious but as it flows down the cañon to the reservoir intake of the pipe line it passes through a mineralized belt and takes up a considerable amount of this.

If the pipe were extended to the spring itself a much larger and better supply of water would be obtained. (See pl. 18, fig. 2.)

Our complete line of traps put out late in the evening did not contain a single mammal on the morning of August 5. Signs of Perognathus were abundant but the animals consistently avoided any bait we offered. We went after them with pick and shovel on the 5th and succeeded in capturing one.

In the afternoon I put some traps out in a cañon about two miles above the camp where the only sign of woodrats had been found on this end of the island. In setting the line I found a rattlesnake in a hole under a bank and Mr. Slevin came to my aid with his trusty pistol. It turned out to be *Crotalus exsul* the type locality of which is Cedros Island.

A good series of fossils from the Pliocene beds south of the camp was obtained during the day.

On August 6 we found our traps had caught one woodrat and three Peromyscus. One more of the latter was taken during the day. Messrs. Tose and Hinkley visited the spring and secured several birds. They also took one cottontail rabbit, a few of which had previously been taken there by some of us.

Mr. Slevin and I went almost to the top of Mt. Cedros northwest of the camp. Stunted cedars are scattered over the upper 1,000 feet of the mountain and cactus was common there. No deer were seen but we came across a small herd of goats. For some reason these animals have not increased as they did on Guadalupe. The elephant trees grow to the very top of the island and some of them, long cut away, indicated a trail. The bark of the tree is white or buff and peels off like a paper birch. The outer layer is very thin; this is followed by a green layer, also very thin; and that in turn by a pulpy part about one inch thick. When the bark is punctured a thick, sticky, cream-like liquid exudes in considerable quantities at the season of our visit. (See pl. 19, fig. 1.)

In the early morning of August 7 the ship was moved to the mouth of Grand Cañon, about the middle of the eastern shore and collections were made throughout the day.

Three male deer were shot and carried to the beach. The animals are here very common, tame and unafraid. One was

taken with the .22 caliber rifle. Trails were well beaten from the shore to the highest point.

In this valley there are some fine groves of elephant trees, the largest seen thus far. The cedars are found from a little above sea level to the top of the mountains but they are small and stunted. No trees comparable to those 12 inches in diameter at Bernstein's spring, were found.

Messrs. Slevin, Anthony, the Chief Engineer of the *Tecate* and I went to the top of the Pine Ridge on the north side of the cañon. This was photographed by Dr. Townsend[18] from the bottom of the cañon and the pine trees standing soldier-like on the rim were mistaken for "cedars." (See pl. 18, fig. 1.) He mentioned "one spring" in the cañon but every branch cañon we explored had one or more. In some there was water in considerable amount but no place was the vegetation as rank as about the one from which Messrs. Bernstein get their water. Above one spring there were the stone walls of an old cabin, long ago abandoned. Some assayer's supplies near by indicated that it may have been a camp of a prospecting party.

On the morning of August 8 our traps contained only one woodrat, two Peromyscus and one Perognathus. Captain Angulo, the Chief Engineer and I went up the cañon again in search of deer and succeeded in getting a female for the collection. This species of deer is found only on Cedros Island and was reported extinct at one time. There were no specimens of it in any western museum prior to our visit, so, in view of the abundance of the species, we felt justified in taking four. The doe taken today was prepared for the National Museum of Mexico.

In view of the fact that the Cedros Island deer has been reduced in numbers, at least once, to the verge of extinction through the activities of hunters and the likelihood of the same being repeated whenever people in large numbers visit that region, the Mexican naturalists on the expedition, Messrs. Cuesta-Terron and Gallegos, determined to make recommendations to their government for some means of protection of the species. Accordingly; upon their return, the situation was explained to the Secretary of Agriculture and Public Works and

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[18] Bull. Am. Mus. Nat. Hist., Vol. 35, 1916, p. 411, fig. 9.

on May 28, 1923, the killing of this deer was prohibited from June 1, 1923, to May 31, 1928, through the issuance of a proclamation by the President of Mexico.

Since this action was taken as a direct result of investigations made by this expedition, the text of the proclamation is herewith quoted in full, the translation into English from the Spanish having been made by Miss M. E. McLellan of the California Academy of Sciences.

SUBJECT

PROCLAMATION PROHIBITING THE KILLING OF CEDROS ISLAND DEER

Alvaro Obregon, Constitutional President of the United States of Mexico, considering that, owing to the excessive hunting of the deer *(Odocoileus cerroensis [cerrosensis])*, the species has greatly diminished on the island of Cedros, situated on the western coast of Lower California, of which reproduction is necessary in order that it does not become extinct, in exercising the power which is conceded to me in clause I of article 89 of the Federal Constitution, and with a basis of the articles 51 in the clause III of the law of the first of October of 1894 and 50 of the law of the twenty-first of December of 1909, I have held well to promulgate the following

REGULATING ORDINANCES WHICH ESTABLISH THE PROHIBITION OF THE HUNTING OF THE DEER *(ODOCOILEUS CERROENSIS [CERROSENSIS])* ON THE ISLAND OF CEDROS.

Article 1.—It is prohibited for five years, beginning with the first day of June next, to hunt, capture, kill, or injure in any way whatever the deer *(Odocoileus cerroensis [cerrosensis])* on the island of Cedros, situated on the western coast of Lower California.

Article 2.—The prohibition includes the distribution or sale of the products originating in the animals referred to in the preceding article.

Article 3.—It will be considered as proof of the infraction of the foregoing article, the use of anything that alters the products of the deer, change of name, or the employment of any other means of deceit.

Article 4.—The violation of the preceding ordinances will be punished by a fine from $50.00 to $500.00, which not being paid, will be commuted to fifteen days imprisonment, and which will be imposed by the Bureau of Agriculture and Public Works or its Agent Generals.

Article 5.—The repetition will be punished by the penalty which, depending upon circumstances, should have been imposed for the last offence committed, with an addition to the fine:

1.—To one sixth part, if the offence shall be less than the former.

2.—To a quarter part, if both shall be of equal gravity.

3.—To one third part, if the last shall be more serious than the preceding.

4.—If the former fine shall have been remitted or the repetition shall not be the first, the amount may be double of that related to the previous infractions.

Article 6.—The act shall be considered a repetition when the culprit has been condemned on a former occasion for an offense of the same kind within the six months previous to the last.

Article 7.—For the imposition of the penalty, there will be considered as accomplices all the persons who by whatsoever means participate in the infractions of the ordinances contained in articles 1 to 3.

Article 8.—Because the Agent Generals of the Bureau of Agriculture and Public Works, imposes the penalties which are mentioned in the preceding articles, they will draw up the related report and transmit a copy of it to the said Bureau.

Article 9.—The fines which are imposed in accordance with the regulations contained in the foregoing articles, will be made effective for the management of the Federal Tax Office, exercising, on its part, the economic-co-operative power determined by the Fiscal Law.

Article 10.—In all cases of the imposition of penalties, the animals captured or killed shall be seized, also the weapons, ammunition, and hunting equipment which are found in the possession of the offenders.

Article 11.—If the animals seized be alive, they shall be returned to the place in which they were taken, and if they be dead, they shall be suitably disposed of. The weapons, ammunition, and equipment seized shall be disposed of by the said Federal Tax Office, except in the cases in which the Bureau of Agriculture and Public Works decides to use them.

Given in the palace of the Executive Federal Power in Mexico, on the seventeenth day of the month of May of one thousand nine hundred and twenty-three.—THE CONSTITUTIONAL PRESIDENT OF THE UNITED STATES OF MEXICO, A. OBREGON.—Published and executed.—THE UNDER SECRETARY OF AGRICULTURE AND PUBLIC WORKS, COMMISSIONER OF THE BUREAU, R. F. DE NEGRI.—Seal.

After lunch the ship was moved to the north end of the island where an extensive mining camp was once located. Three old buildings and the remnants of a wharf were still standing near the beach although they had not been utilized for about 25 years. Several burros greeted us upon our arrival. They apparently still had memories of their human associations.

Messrs. Tose and Hinkley worked up the cañon toward the old mine and, with the exercise of the greatest care succeded in getting only one bird, a Say's flycatcher. This is a fair commentary on the scarcity and wildness of the birds of Cedros. There must be a reason for this situation but, try as we would, we could not learn what it was.

Fishes were excessively abundant and several large jewfish were hooked at the anchorage.[10] Sardines formed a zone for half a mile out to sea. Mr. Anthony saw schools of yellow-tailed tuna 100 yards wide and half a mile long, and inshore numerous small "halibut" were caught "jumping" from the water. Out in a boat over the rocks and kelp gardens it was bewildering to watch the constant struggle for existence among the living things. When a tuna or barracuda entered the shoals of smaller fishes pandemonium reigned for several minutes. The sardines are preyed upon from below by many fishes and above by the birds. Their existence must be one adventure after another.

From the observations thus far made it appears that the greater part of Cedros Island is composed largely of Jurassic sediments—Franciscan cherts, sandstones, and in one place in Grand Cañon, conglomerate. Much alteration and metamorphism has taken place and from the excessive amount of fracturing it appears to be on or near a fault zone. At the southwestern corner of the island there has been some volcanism and at the north end the land is greatly disturbed with intrusions of serpentine. On the eastern side there are Pliocene sediments at one and probably two points.

On August 9 Messrs. Anthony, Slevin and I went up a cañon south of the landing to the top of Gill Peak, thence north down the mountain side through a pine forest to the old mine. From the top of the mountain we could see the western shore of the island with its extensive outlying kelp beds. This was the habitat of numerous sea otters about 100 years ago but if any are left they are very scarce. We saw none nor did we hear any reports of any. Except for the work we did later on the southwest side of the island the western shore is unexplored, biologically.

Extensive operations have been undertaken at the old mine. About 20 buildings and much of the machinery remain on the ground. The ore is a white rock said to have been rather rich in copper and gold. Large quantities were shipped from the mine to San Diego for smelting but this form of operation did not pay. We could not investigate the underground workings

[10] See Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, p. 83.

because of caving at the entrance. The ore on the dump was leached and the stream bed below was blue green in color. In operation the ore was hauled in carts down the steep cañon bottom to the wharf. A cobblestone road was built in the creek bed at great expense but it has almost completely washed out. Pipe lines are mostly rusted out and the entire plant is in an advanced state of decay. A visit to such a place makes one sad to think of the great amount of toil and money used and hardship endured for naught. It is a graveyard of human effort.

Messrs. Tose and Hinkley saw four more deer during the day but did not take any of them. On our trip to Gill Peak we saw only abundant signs of the animals. During this entire trip of about seven hours' duration we saw four land birds and four only. These were three wrens and a shrike.

Late in the evening Mr. Anthony and I visited the sea-lion rookery at the north end and estimated the number of animals at approximately 1000. Harems had completely broken up and the herd was hauled on the beaches away from the rookery ground. We wanted to be sure no fur seals had hauled out here near the sea lions. On the way back we were greatly impressed by the inconceivable numbers of fishes in these clear waters.

On the morning of August 10 Messrs. Tose and Hinkley returned to the ship after a cold night spent sleeping in the hills. They wanted to be out late in the evening and at daylight in the morning in hopes of securing specimens which otherwise are unobtainable, particularly birds, but little success attended their commendable efforts. They did bring back another male deer.

At seven-thirty a. m. we left the mine anchorage and returned again to Bernstein's camp. His launch, the *Marian,* had been there the day before and left supplies for the *Tecate.* At anchor we found the auxiliary schooner, *Gipsy Girl,* from San Pedro, California, with Captain Farnsworth, Mr. Peabody and Dr. Spencer on board.

We left the anchorage the same day and stopped for the night at the west end of South Bay, too late to explore much.

Traps were put out, however, and next morning, August 11, they contained six Peromyscus and one Perognathus. At six a. m. we sailed around the southwest corner of Cedros to the abalone collecting station maintained by Bernstein Brothers. The station is on the southwest peninsula in the protection of some off shore projections called "Red Rocks."

Messrs. Tose, Hinkley and Slevin went ashore collecting at eight a. m. After tramping all day and until five p. m. that evening, the ornithologists came back with the news that they had found a skull of an elephant seal on the beach. This was an interesting record as it showed something of the former distribution of the species. After nine hours of search the same men saw only one land bird, a wren. Mr. Slevin took 57 lizards representing only two species. Messrs. Cuesta-Terron, Gonzales, Angulo, Anthony and I visited the abalone divers at work in the kelp and examined the red rocks at close range. The outer one had 50, the inner 250 California sea lions, but no fur seals. Both islands are low and the surf breaks over them in storms.

One of the men at the camp had killed a female deer that morning and he gave us the skin and skull. He also gave us two other skins, a pair of fine buck horns and a good skull of a porpoise.

We ate lunch on shore at the camp and at two p. m. I went down in one of the diver's outfits in 24 feet of water. It was the most marvelous sight I have ever seen. The sensation experienced of moving about among the fishes, the star fishes, the anemones and the giant swaying fronds of seaweed is indescribable. Purple coraline algæ covers much of the rocky bottom at this point and against it as a background the golden garibaldis looked like gems. Many other fishes swam about and inspected me from all angles. It was rather disconcerting to have them stare into the helmet at me. Abalones were very common but they carried so many other things about, growing commensually on their shells, that they were difficult to see at first. The diver in operation prys them loose with a bar and puts them in an iron basket to be hauled to the surface. These men stay down for four hours at a time but I found it very fatiguing after a few minutes.

The country in the vicinity of this camp is exceedingly barren and dry.[20] There is very little vegetation of any kind. One of the men told us there was a third giant cactus tree on the west side of Cedros Mountain in addition to the two found by Mr. Slevin and me on the south side. This may be of interest to botanists because the species would very likely be overlooked on casual inspection of the island, yet it is a definite resident. The two individuals we examined were about 15 feet high.

During our stay on Cedros Island we did not see any of the dogs which are said to have gone wild on the island. Cats are said also to be found in the hills, and the people at Bernstein's main camp had a gentle young kitten which they said had come to them two months previously.

At seven a. m. of August 12 we left the abalone station at Red Rocks after taking up the traps and the six wild mice they contained. The ship was taken to the harbor on West Benito Island, where we went ashore at nine-thirty a. m. Messrs. Cuesta-Terron, Anthony and I spent the rest of the forenoon surveying the shores for fur seals but we found none. It has been reported that these animals may have been on the San Benito Islands since they were exterminated on Guadalupe. Mr. Rufus A. Coleman, a member of the California Academy of Sciences, visited West Benito in 1916 with the steamer *Albatross* and saw some animals which he thought possibly may have been fur seals. We found only about 150 California sea lions on the rookery ground.

On the beach opposite the landing we found many bones of elephant seals and four fairly good skulls were saved. Our cook on the *Tecate* stated that he was on West Benito six months in 1918 in a lobster camp and saw two elephant seals on the same beach. About the same time six were found on the southeast corner of East Benito, one of which he shot. The islands were probably used only for a hauling ground and the presence of these remains here, on Cedros Island, and the animals found in 1888 at San Cristobal Bay, may furnish a clue as to the migration of the species from Guadalupe. Miss M. E. McLellan has called attention to the belief of some naturalists[21]

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[20] See figure in Nat. Geog. Magazine, Vol. 44, No. 1, July, 1923, p. 90.
[21] See Anthony, Journ. Mammalogy, Vol. 5, No. 3, 1924, p. 149.

that the elephant seal of Chile and Guadalupe are one and the same species. While statements of Harris and Rothschild[22] cannot as yet be definitely disproved it is doubtful if the northern animal can cross the equator twice each year and still be where the records show it to have been on certain dates. The two groups may be the same species but I doubt if they are part of the same herd and if they ever associate together.

The afternoon of August 12 was spent in general collecting. Least, black and Soccoro petrels were taken from burrows and in rock slides. (See pl. 17, fig. 3.) Some fresh eggs were found. A specimen of McGregor's house finch, confined to the San Benitos, was one of the very desirable species of birds taken. San Benito sparrows were common.

Land shells *(Micrarionta pandoræ)* were living in abundance in the rock slides and a sufficient number was taken to study the excessive variation of the species.

House cats have gone wild on this island as on most of the others visited.

On West Benito there was a camp for the collection and drying of abalones; it was owned by a Japanese who had a concession for the work. Large quantities of "meats" were on the frames drying and the methods employed were essentially the same as those already described. All fuel and freshwater has to be brought from San Diego as there is none of either on the San Benitos.[23]

No signs of mice or rats were seen on West Benito Island but lizards belonging to one species were common.

In the early morning light of August 13 Messrs. Slevin, Anthony and I rowed to Middle Benito Island for two hours' collecting. No land shells were found but many desirable beetles were collected. San Benito sparrows and a duck hawk were collected. Least, Socorro and black petrels and western gulls nest on the island. Cats are apparently very abundant if we may judge by the remains of petrels about the burrows. A great many elephant seals and sea lions have been killed on the

[22] Rothschild, Notes on Sea Elephants (Novitates Zoologicæ, Vol. 17, 1910, pp. 445, 446).

[23] See figure in Nat. Geog. Magazine, Vol. 44, No. 1, July, 1923, p. 94.

island in the past; their bones were abundant. Many bones of whales also were seen.

No mice or rats were found on the island but there were small lizards belonging to the genus Uta.

After breakfast the ship was moved to East Benito and 4½ hours were spent in shore collecting. Land shells of the Micrarionta group were abundant and I found another species belonging to the family Pupillidæ not previously known from the islands. It was found only in one rock pile on the east side of the island.

San Benito sparrows were collected and I took a mummified hermit thrush from the thorns of a "cholla." One house finch was seen. That species is now practicaly extinct and it is somewhat doubtful if any other field collector will ever see it alive. If the absence of the birds was due to migration then the distinctness of the form might well be questioned. Pelicans nest on the east side of the island and Brandt's cormorants on the west.

About 1,000 California sea lions were found on the east side in the "fiords." Mr. Slevin took lizards belonging to the genus Uta on this island. On East Benito Island I had the interesting experience of being stung on the knee by a scorpion, and thus an opportunity was afforded to test the "deadliness" of this arachnid. The sensation was about that of being stung by a honey bee but the pain did not last as long. A slight but temporary swelling resulted and the spot was red for perhaps a week. An hour after the sting the wound would never have been noticed except for a slight itching which was noticeable for fully a month afterwards.

There is some evidence of house mice on East Benito; many small land shells were broken open in a manner similar to those on Guadalupe, the work there having been attributed to the mice. Cats were also abundant on East Benito and they were wreaking havoc among the petrels.

The three San Benito Islands are small and close together in an east-west line. The westernmost one is about 661 feet high and is composed largely of Franciscan chert of Jurassic age, beautifully contorted and laminated. There has been some

metamorphism of the sediments on the south side.[24] The Middle Island, the smallest of the three, is composed entirely of chert. East Benito is high and rugged and largely metamorphic. Schist, marble and quartz are abundant rocks. Only the tops of the three conspicuous hills disclose the Franciscan chert formation. All of the islands show the Pleistocene submergence and subsequent uplift. They were not down long because the sediments deposited are very superficial. The eastern island seems to have been down the shortest time and the fiord formation of the shore line indicates that it was not elevated to the original level again.

Most of the available shore lines of the islands were occupied by California sea lions.[24]

We left East Benito Island at two p. m. for San Quintin Bay. A brisk northerly wind and heavy swell held us back all afternoon and the following night.

We arrived at San Quintin at noon of August 14 and hurriedly took on fuel. This being completed at two-thirty p. m. we left at once for San Martin Island, near the entrance of the bay. It was five-thirty p. m. before we were safely anchored but all of the party hurried ashore to collect as much as possible before darkness overtook us.

The main part of the island is volcanic, and densely covered with cactus, brush and huge blocks of lava. Caves and blowholes are everywhere and at the top there is a crater.

Several species of plants are found only on this island, one being a magnificent Dudleya waist high.

The deep cavities and crevices are occupied by numerous woodrats with black feet. The Japanese in the past have attempted to destroy these rodents, first by introducing cats then by burning the brush systematically but neither course proved effective. The cats appear to live on birds and beach débris.

A frame house in good condition was formerly occupied by a Japanese abalone camp but was empty at the time of our visit. Net racks close by were being used by the purse seiners to repair their fishing gear. Three of their boats anchored in the little cove where we were for the night. They were manned by Austrians.

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[24] See figures in Nat. Geog. Mag., Vol. 44, No. 1, July, 1923, pp. 86, 87.

I succeeded in finding four or five species of land snails on the island and Mr. Tose collected a rock wren, which has been described as a distinct subspecies.

A snake was seen among the great lava blocks but it could not be captured, much to the regret of Mr. Slevin; no species had ever been collected on San Martin.

At seven p. m. the boats were hoisted and we sailed for Ensenada. This we reached at nine a. m. of August 15. The day in port was largely spent in packing collections and equipment and making general preparations to disembark next day at San Diego. This we did at nine a. m. when the expedition came to its logical end.

Fig. 1 The Mexican Government's Fisheries Patrol Boat, *Tecate*, at anchor at East Benito Island The *Tecate* was motor driven and had a cruising radius of about 1000 miles.

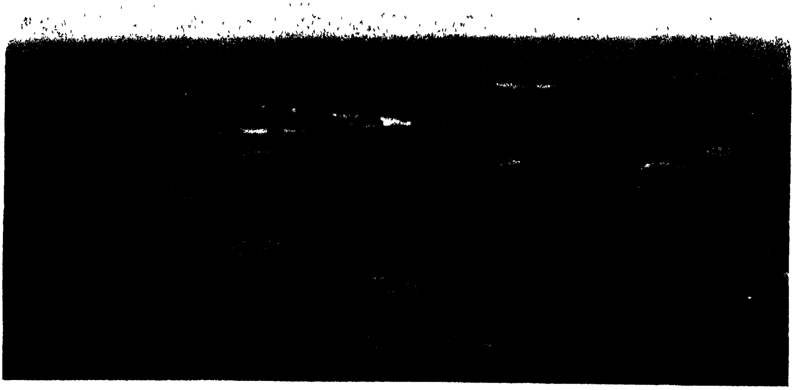

Fig. 2. One of the circular, flat-topped piles of stones on the smooth "pegging out" ground of the ancient fur seal killing ground of South Rookery, Guadalupe Island. Presumably these piles of stones were used as a place to assemble the skins so as to keep them clean, either before or after drying, but probably before.

Fig. 1. A general view of the herd of elephant seals on the beach at Guadalupe Island, July 12, 1922

Fig. 2. A full grown male elephant seal in characteristic resting attitude on the beach at Guadalupe Island.

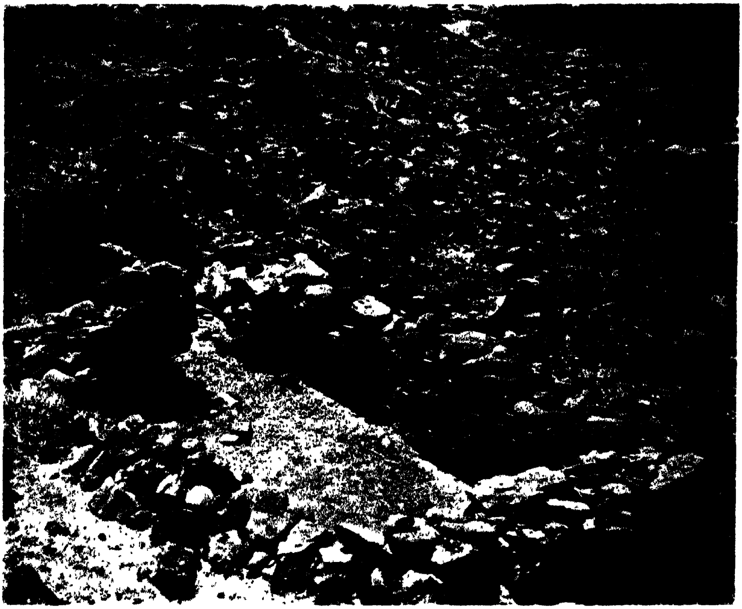

Fig. 1. Walls of one of the houses occupied about a century ago by the hunters who succeeded in totally exterminating the fine Guadalupe Island fur seal.

Fig. 2. Guadalupe Island house finch. Fig. 3. Downy young of black petrel on West Benito Island.

Fig 1. Grove of pine trees on the crest of a ridge on the north side of Grand Cañon, Cedros Island. These have been erroneously called "cedar trees" (See Townsend, Bull Am. Mus. Nat Hist., Vol 35, 1916, fig 9, p 412.)

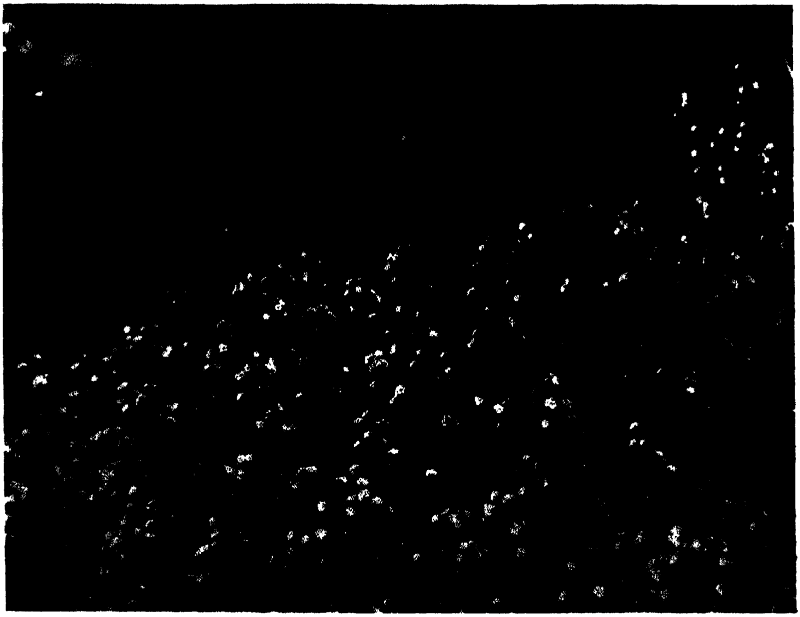

Fig. 2. Vegetation in the little oasis surrounding Bernstein's Spring, the largest supply of potable water on any of the islands off the west coast of Lower California.

Fig. 1. Characteristic attitude of Cedros Island elephant tree; the barrenness of the landscape otherwise, is noteworthy.

Fig. 2. A portion of the grove of palm trees in Esparsa Cañon, Guadalupe Island. No young trees or seedlings could be found, and unless the species is transplanted to safe surroundings, it must inevitably disappear, due to the depredation of the goats on the island.

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XIII

EXPEDITION TO GUADALUPE ISLAND, MEXICO, IN 1922[1]

THE BIRDS AND MAMMALS

BY

A. W. ANTHONY

The "Tecate" sailed from San Diego, July 9, touching at Ensenada the same day to pick up several of the Mexican members of the party. From that port it sailed direct to Guadalupe Island which was circumnavigated. A week was devoted to that island, including two trips to the top and pine belt at the north end. From Guadalupe the vessel returned for fuel to San Quintin, where three days were spent making investigations before proceeding to Magdalena Bay and return, touching at all the coast islands en route with the exception of San Geronimo, as well as collecting to a limited extent at several mainland points. The expedition returned to San Diego, August 16, having sailed over 1,400 miles.

Owing to the season, the collections of birds were quite unsatisfactory, all species being in moulting condition. However, the expedition served as a reconnoissance to enable us to plan for further work in the future.

As there have been but few papers treating of the insular life of Lower California, a brief sketch of the islands in their relation to the mainland may be of interest. With the exception of Guadalupe, all the islands of that part of the coast have

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[1] This is paper No. 2 of the *Tecate* Expedition. No. 1, the Narrative, gives a complete itinerary. See this volume, pp. 217-275.

at some time been a part of the mainland. All but the above exception lie at no great distance off shore and the water between is of a depth indicating a somewhat recent separation. At all points from San Quintin south to Magdalena Bay, including both islands and mainland, is found abundant evidence of a recent uprising of from 20 to 30 feet above the present sea level. In his paper on the geology of this section, Dr. Hanna will treat this subject in full.

Land mammals are found on all of the islands with the exception of Guadalupe and the Benitos. The first mentioned has neither reptiles nor mammals, except introduced mice, goats and cats, while the Benitos boast one species of lizard. Cedros, lying 15 miles from nearest points of the mainland, is the largest island, save those bordering Magdalena Bay on the west, which are so nearly a part of the mainland as to bar them from the brotherhood of islands. Viscaino, in 1602, visited Cedros, and he, with other explorers of this early day, mentions rabbits as "black as jet with fur softer than a beaver's." They must have been well bleached since that day, and have been ever since I have known them. Some of the early Spanish explorers also credit Cedros with a considerable population of "bold Indians." So far as present records go, there is no evidence of this or other coast islands south of the Coronados ever having been inhabited by Indians.

At an early date a coast whaler left goats on Guadalupe and Cedros, with the evident intent of securing a supply of fresh meat. Though Cedros seems to be better suited than Guadalupe for the requirements of a reasonable goat, they never seem to have become overly abundant on that island. Guadalupe, however, has been for many years so overstocked, despite the thousands that have been killed, that the entire floral life of the island is doomed. Many species of plants, and some genera peculiar to the island, have been entirely exterminated, and not even a pine, oak or palm can look down upon a seedling to replace the aged trees now beginning to fall. A sprout of any kind is nipped as soon as it is above the soil. It is estimated that a goat census of Guadalupe would show from 30,000 to 50,000 animals. As long ago as 1887, when the present writer first became acquainted with the islands, 15,000 goat skins per

annum were being exported without causing any noticeable difference in the herds. Since that day, many concessionaires have attempted the business and failed, owing to the slight difference between the cost of skins and the selling price on the mainland.

If the goats have been busy in reducing the floral list of the island, the cats that were introduced at some time in the past have lost no time in exterminating the birds. At this date all of the land species have been reduced to no better than ten per cent of their abundance in 1887, and several have entirely disappeared. For several years past there have been no records of the Guadalupe Caracara, flicker, towhee or wren *(Thryomanes brevicauda)*, and they no doubt are totally extinct. Kinglets and crossbills, formerly plentiful in the pines at the north end of the island, were not found by us, and they quite likely belong to the list of those destroyed by cats. The end of all the land species of the islands, with the exception of such as *Buteo borealis calurus*, is a matter of but a few years. Within the past 25 years the fishermen of the Lower California coast, chiefly Japanese, have introduced cats on every island north of Magdalena Bay, and the effect is noticeable at this early day.

Upon the San Benito Islands, the land birds, abundant but a few years ago, have almost disappeared. At the time I last called at these islands in 1898, one might easily have collected a dozen *Carpodacus mcgregori* in an hour. In August of the current year, four of our party for two days made this species a special object, with the result that one was secured and another seen. Petrels and other small water birds have also suffered heavily on Guadalupe, and unless there may be some other as yet undiscovered nesting ground of the Guadalupe Petrel it will soon be extinct. The only known colony at the north end of Guadalupe seems to be entirely destroyed. A few birds seem to have been nesting in the cliffs, and if such colonies are sufficiently extensive the species may endure for several years.

The present list of birds and mammals is of species seen and mostly collected, but one or two are included on evidence furnished by others; the source of such data is mentioned in the text. Many species not mentioned are known to occur

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within the limits of the region covered, but after an absence of a quarter of a century, I am in doubt as to their present status and will leave them for future investigation.

LIST OF SPECIES OF BIRDS

1. **Ptychoramphus aleuticus.** Cassin's Auklet

This species was quite common at all seasons as far south as 28 degrees, at least. At the time of our visit, all had abandoned their nesting grounds and were at sea. Nowhere did we see flocks of more than five or six—more often single birds or pairs. Two specimens in badly worn plumage were taken at Guadalupe.

2. **Brachyramphus hypoleucus.** Xantus's Murrelet

This species was in badly worn plumage and several of the birds seen at sea seemed unable to leave the water. They were not uncommon as far south as Magdalena, but none was found on land. In digging for eggs of Oceanodroma at San Benito Island, August 12, a downy *O. monorhis* was found in a burrow with an addled egg of the Murrelet. I have never found this species nesting in a burrow of this nature, the many eggs that I have taken in the past being either among the rocks or under overhanging curtains of thick grass or other vegetation. In either situation, subdued daylight reached the brooding bird. I am inclined to think this Murrelet pairs for life, as it is quite the rule to find either a pair of birds or at most two pairs in company.

3. **Stercorarius parasiticus.** Parasitic Jaeger

This species is not uncommon along the coast covered, but is not often seen as early as August. On July 31 three or four were noted south of Abreojos Point, Lat. 26° 40′ N. They were not seen again.

4. **Larus occidentalis.** Western Gull

The dominant species of the genus, and the only one nesting at present in the region under discussion. About Guadalupe Island a few were seen, July 11 to 17, with young not yet on

the wing. There seemed to be only a scattering few gulls about this off-shore island, as not over 10 to 12 pairs were seen at any one spot. On all other islands they are more or less abundant as far as Magdalena Bay. Young, but a short time from the egg, were seen as late as the first of August, and these belated broods may perhaps be due to the rookeries being raided earlier in the season by fishermen, who take the eggs as long as they can be found in an edible condition.

5. **Larus heermanni.** Heermann's Gull

On the voyage south, this species was not seen until we reached San Quintin Bay, July 18, where a dozen in juvenile plumage were noted. They were seen sparingly south to Magdalena Bay, and on August 2 at San Roque Island a flock of about 1,000 were met with, mostly immature birds. Formerly there was a nesting colony on this island, but from indications I would say it has been destroyed by the resident fishermen. From notes furnished me by those who have recently visited the nesting grounds of this gull in the Gulf of California, I do not hesitate to state that unless protection is offered at once the species will soon be extinct. Large colonies are still found nesting on the islands to the west of Guaymas, but boats from that port haunt the nesting grounds as long as there is any chance of securing one more egg, and the egg that hatched has been the rare exception. A few years ago this was one of our common gulls along the coast of California, as far north as Santa Barbara. At all seasons of the year a few at least might be depended upon to be found along the kelp beds outside the harbor of San Diego. During the past six years only one has been noted. A few seen on the rocks at La Jolla, fifteen miles north of San Diego, the past year are all that I have any record of.

6. **Xema sabini.** Sabine's Gull(?)

Off Abreojos Point, July 31, we met with large flocks of shearwaters and elegant terns feeding on the very abundant fry. With the thousands of the above species were several small gulls that filled the requirements for this species better than any other. Owing to their distance from the boat, positive

identification was impossible. We again fell in with 25 or more of the same species off Todos Santos Islands, August 15, under exactly similar conditions.

7. **Sterna maxima.** Royal Tern

Formerly this species, like the Heermann's Gull, was abundant all along the coast of southern and Lower California. They were seen at San Quintin Bay and Cedros Island during our voyage in July and August, but only in very small numbers. I can only attribute their scarcity to the fact that the fishermen have raided the nesting grounds to such an extent that the species is becoming rare on this coast.

8. **Sterna elegans.** Elegant Tern

The elegant tern was seen at several stations from San Quintin south to Magdalena Bay, but like the royal, there were but few compared to their former abundance. At Abreojos Point, however, on July 31, we found a large mixed flock of sea birds feeding on sardines. Ninety-eight per cent of the flock—estimated to be 25,000 birds—was of this species, with young of the year predominating. I have been told that formerly there was a large nesting colony of this species on San Roque or Asuncion Island, but that the constant persecution had driven them away. As all of the islands along this coast for 500 miles are used as permanent fishing camps during the entire nesting season, and as the Japanese and Austrians composing the personnel of these stations depend on eggs for their table, so long as any are to be found, there would seem to be small chance for any of the gulls and terns. If the toll of eggs exacted by the fisherman was the sum total paid, the damage might be safely disregarded, but as will be instantly recognized by any who have visited an island where gulls are to be found,. and terns or cormorants are nesting, the real slaughter begins when man, followed by a cloud of screaming gulls, drives the nesting birds from their eggs or young. The gulls, pouncing down on the undefended nests, destroy eggs or young by thousands, and a frequent disturbance of this nature, even though no eggs are taken by the fishermen, will naturally destroy the species.

9. **Sterna forsteri.** Forster's Tern

A few of this species were seen with the last mentioned at Abreojos Point, also a few at San Quintin Bay on August 14, the vanguard of the fall migration.

10. **Sterna antillarum.** Least Tern

At Abreojos Point there were half a dozen of the least terns fishing in the shallow water inside the surf line. They did not seem to care for the company of the thousands of their larger cousins and the deeper waters.

11. **Chlidonias nigra surinamensis.** Black Tern

One or two of the black terns were seen with the large flock of elegant terns at Abreojos, and a day or two later a few along the kelp beds 100 miles north. This species is not uncommon during the fall migrations about the kelp beds of the entire coast, but does not seem to linger long.

12. **Diomedea nigripes.** Black-footed Albatross

This species seems to be far less common along the southern coast than it was 25 years ago. On our cruise to Magdalena Bay none was seen until we neared Guadalupe Island, July 11, when two were picked up at daybreak and followed the ship until we reached the island. They were seen sparingly as far south as between 25° and 26°. Formerly I found the short-tailed albatross *(D. albatrus)* equally common and over the same range as *nigripes*, but none was seen the past summer, nor have I seen during the past two years an albatross of either species between Point Loma and the Coronado Islands, where they were formerly of regular occurrence, though I have visited these islands perhaps 20 times within the time mentioned. The raids made by the Japanese on the nesting colonies between Hawaii and Japan no doubt account for the present scarcity of birds along our coast.

13. **Fulmarus glacialis.** Fulmar

The skull of a fulmar was picked up on the beach at the south end of Cedros Island. While fulmars are more or less common during the winter months along this coast, we were too early to meet with them.

14. **Puffinus creatopus.** Pink-footed Shearwater

This species was found more or less abundant all along the coast and for 50 miles or more at sea. Their presence seemed, as with all of the other shearwaters, to depend entirely on the small fish on which they feed. At several points along the shore flocks of many thousands of shearwaters were seen. Always such flocks were composed of the several species of Puffinus found on this coast, with a sprinkling of gulls, cormorants and pelicans.

15. **Puffinus opisthomelas.** Black-vented Shearwater

Generally distributed over the entire region covered by the expedition and by far more abundant near Natividad Island, where the largest known nesting colonies are found. On August 4th, Dr. Hanna and the writer opened 25 or more burrows, with the result that four birds were secured, one being a juvenile, showing but little of the natal down, otherwise the plumage was not to be distinguished from the adults. From the tracks about the burrows I think that the birds visited the nests each night, though for what reason after the young had departed, would be hard to say. On a former visit to Natividad, in September, I found fresh tracks about the entrances of the burrows, but did not succeed in taking any birds, though many nests were opened. Fresh eggs in abundance have been found in the Natividad colonies in April, the birds beginning to occupy the burrows some weeks earlier but at just what date we have, as yet, no records, but it is evident that at least five months are spent in the region of the breeding grounds. On Natividad, as at Guadalupe and the San Benitos where this species nests to some extent, the introduced cats have killed many adult birds. As cats have been recorded on all of the known nesting islands of the species, it would seem

to be only a matter of time until the shearwater will be extinct. On two or three occasions shearwaters, the size of *opisthomelas,* were seen that were ashy gray above and below but otherwise similar to that species. No specimens having been secured it is not safe to venture at identification.

16. **Puffinus griseus.** Sooty Shearwater

The notes on *P. creatopus* will apply to this species as well. They were quite common wherever large flocks of shearwaters were met with, which was whenever we encountered schools of small fish.

17. **Puffinus bulleri.** New Zealand Shearwater

The positive identification of a shearwater at gunshot range is somewhat of a venture and as no specimens of this species were obtained it might seem dangerous to include the species among those noted. However, a large Puffinus with pure white underparts and other characters assigned to *bulleri* was frequently seen between Ensenada and Magdalena Bay, and I have little doubt as to its being this species. In April, 1897, I met with similar birds as far south as Cape St. Lucas. At that time they all seemed to be flying north in either quite small, scattered flocks or singly. None was taken, but I then, as now, would unhesitatingly pronounce them *bulleri.* If it is not this species it is probably *P. chlororhynchus.*

18. **Halocyptena microsoma.** Least Petrel

This diminutive petrel was not noted until we were nearly at Magdalena Bay, when a few were seen at sea (July 24). They were inconspicuous at all times, owing, perhaps, to the fact that it was their nesting season and only the non-breeders might be expected at any distance from the San Benito Islands, which is their only breeding ground so far recorded. On these islands we found them abundant, August 12, at which date we took fresh eggs and downy young, the last a ball of down, smoky black in color. So far as my experience goes,

the least petrel does not nest in a burrow in the ground as do the different species of Oceanodroma with which I am familiar. Of the many nests I have seen, all were in bare rocky slides, or similar localities in the rocks, where subdued light might reach the bird.

19. **Oceanodroma leucorhoa kaedingi.** Kaeding's Petrel

While the *Tecate* lay at anchor at the north anchorage at Guadalupe, July 11-16, this species was quite in evidence, evidently nesting in the high lava cliffs that almost overhung the beach. Soon after nightfall their calls might be heard, as those birds that had spent the day at sea came in to land. After 11 p. m. there was comparative quiet until just before daybreak, when for a short time the calling began once more, to cease entirely at dawn. The lights of the vessel attracted a number of birds aboard and these constitute the only specimens taken, except a juvenile about a week old that was taken from a crevice in the lava. This specimen, No. 25561, California Academy of Sciences, is nearly uniform sooty gray, slightly lighter below. A few petrels that were considered *kaedingi* were seen at sea as far south as Ballenas Bay, but they were by no means common even in the region of their nesting grounds on Guadalupe. Dead bodies of this species were found impaled on the needle-like spines of the "cholla" cactus which is quite common on many parts of Guadalupe, the bird evidently having flown into the death trap in the dark. Cats also have taken a large toll, as is attested by the many half-eaten bodies in many parts of the island.

20. **Oceanodroma macrodactyla.** Guadalupe Petrel

Guadalupe Island is, so far, the only recorded habitat of this species. In my several visits to this island I have never seen the bird except as I took them from the nesting burrows. They nest far earlier than the other species of the genus, half-grown young being found as early as May 25, while August would produce young of *O. melania* of similar size. It is, of course, highly probable that the species leaves the island at the end of

the nesting season, but its whereabouts during that part of the year when it is not at home at Guadalupe still remains a mystery. In former years there was a considerable colony along the ridge in the pine growth at the north end of the island. The present writer visited this spot May 26, 1892, and found the birds abundant. In July of the current year the same ridge was explored and but little was seen to indicate a recent occupation of the nesting ground. A few burrows were seen, but they seemed to be very old. In 1892 dozens of dead birds were seen, where cats had torn away the breast, leaving wings and tail, enough to identify the species. Half a dozen similar dried bodies were seen last July, but so few that we were of the opinion the colony was about finished.

21. **Oceanodroma melania.** Black Petrel

This species was seen more or less commonly from the time we left San Diego until we returned, but was rare; nor was it seen at all far from shore. Nests are not uncommon on the Coronado Islands, but on the San Benito Islands are perhaps the largest breeding grounds of the species so far discovered. August 12, we found many nesting birds with eggs fresh to hatching as well as half-grown young. The nests were usually at the end of a crooked burrow, some two and one-half feet to four feet from the entrance, though a few were found in loose, shelly rock slides. This and the other species of the genus found on the coast might select a similar location and often do, but this is more often in stygian darkness at the end of a three-foot burrow. This species, in common with the other smaller birds of the Benitos, has suffered heavily from the introduced cats.

22. **Oceanodroma monorhis.** Swinhoe's Fork-tailed Petrel

It is with considerable hesitation that I attempt a classification of this group. *O. "socorroensis"* has in the past been the accepted species, being more or less common from the Coronado Islands to the San Benitos during the nesting season. I cannot say at this writing just how many times in the past I

have taken from the same nesting burrow white-rumped "*socorroensis*" and equally typical "*monorhis*" with no white at all, but if I were to trust to memory, I would say that that was as often the case as otherwise. I have before me birds from the Coronado Islands as well as from the Benitos that agree exactly with the descriptions and measurements of *monorhis,* and that were from the same colonies as white-rumped birds or those with white flanks. Unfortunately the collectors neglected to so mark the specimens as to enable one to separate the "pairs" where two birds were found in the same burrow. A large series of petrels, from either of the above localities, shows that one might by selection separate several species or races were it not for the troublesome intergrades. Birds with pure white rumps, those with white flanks and every form of gradation to sooty-black and typical *monorhis* can be selected. At this writing, and in the light of the material before me, it might seem the safer course to sidestep the issue and leave the decision to further developmnts. Letters, however, from W. E. Clyde Todd, of the Carnegie Museum at Pittsburgh, and Mr. A. J. Van Rossem, of Pasadena, California, both of whom have access to large series of the "*socorroensis—monorhis*" group would indicate that there was but a single species represented with a wide variation in the plumage of the rump. At San Benito Island we found the birds nesting August 12, and secured fresh eggs as well as young a week or more from the egg. We saw the species at sea as far south as Magdalena Bay, where, on July 27, a few were seen inside the entrance of the bay in company with *O. melania.*

23. **Phalacrocorax auritus albociliatus.** Farallon Cormorant

Seen more or less commonly as far as Magdalena Bay, but very largely replaced by the following species south of Abreojos Point. During the first half of August this species, in common with the Brandt's, was found nesting on all of the islands north of 27°. Fresh eggs, those far advanced in incubation, and from that to young on the wing, was the status of all the rookeries visited as late as August 13. I think the lack of uniformity may be accounted for by the destruction of

the eggs by western gulls. The two species of cormorants breeding along this coast are more extensively preyed upon by the gulls than any other species and should the cormorants be driven from the nests, eggs and young by the hundreds are immediately destroyed. As has been noted earlier in this paper, all of the islands are used, during a great part of the year, by fishermen, who undoubtedly cause a very disturbed condition, innocently or otherwise. They are the indirect cause of the destruction of many thousands of cormorants as well as other sea birds. The Farallon cormorants were always found occupying the higher and more precipitous parts of the islands, leaving to the following species the gentle slopes and level land.

24. **Phalacrocorax penicillatus.** Brandt's Cormorant

Much more abundant than the preceding species. Despite the disturbed condition of the nesting grounds, there were large rookeries on most of the islands visited. On the more level parts of San Roque and Asuncion were several large rookeries that at the time of our visit were occupied by hundreds of young, ranging from those able to fly to squabs but just hatched. As one approached the nesting grounds, the young crowded toward the side farthest removed from the intruder, until it seemed as if it would be impossible to introduce another bird into the interior without the aid of a wedge, so tightly were they massed. As the danger became more evident, the compact raft moved faster, the older birds in the lead progressing by a series of awkward hops which soon left the younger members behind. As more speed seemed desirable the wings were called upon, waved about like flails, and so upset the balance that immediately the youngster that was merely in a slow hurry at best was thrown forward on his face and quite as often as otherwise stepped on his own neck and was unable to get up. If crowded, the half-grown young will take to the water and escape by swimming, though many times such birds are unable to regain the nesting ground owing to the low cliffs bordering the sea below the rookeries. The fate of such birds is somewhat doubtful, as they are as yet unable to secure their own food.

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25. **Pelecanus californicus.** California Brown Pelican

An abundant species along shore throughout the trip, but rare in deeper waters. A single immature bird seen at Guadalupe is my only off-shore record. At Magdalena Bay they were noticeably more abundant than at any point north. At many of the islands, notably San Roque and Asuncion, we found fresh eggs and newly hatched young, as well as birds on the wing. As only a single brood is raised and young are to be found in late February or early March, the late nesting can only be explained on the ground of reported disturbances, as noted under species above mentioned.

26. **Fregata aquila.** Man-o'-war-bird

Very abundant south of 26°. This species formerly nested extensively in the mangrove swamps about Magdalena Bay, but repeated raids on the part of the natives who use the eggs for food have reduced their numbers. Owing to the nature of the mangrove growth, it is quite difficult to reach the nests, which fact has been the only restraining influence in preserving the nesting grounds in this region.

27. **Oidemia perspicillata.** Surf Scoter

A few only seen in San Quintin Bay—non-breeding birds, no doubt, that did not migrate. Such cases are common. During the winter the species is very abundant all along the coast.

28. **Erismatura jamaicensis.** Ruddy Duck

A single bird in San Quintin Bay is the only record for the voyage.

29. **Guara alba.** White Ibis

Seen only in the mangroves at Magdalena Bay, where it was not very abundant. As the more remote parts of the jungle north of the settlement were not visited, it may be that the species was less rare than our observations would indicate.

30. **Ardea herodias sanctilucæ.** Espiritu Santo Heron

Not uncommon on the islands near shore and at most, if not all, of the mainland stations. Two or three were seen at Guadalupe Island.

31. **Hydranassa tricolor ruficollis.** Louisiana Heron

Seen only in the mangroves about Magdalena Bay, where it was common. Formerly I have taken specimens as far north as San Quintin, but I think it was never abundant there.

32. **Butorides virescens frazari.** Frazar's Green Heron

Found not uncommonly at Magdalena Bay, where they shared the mangrove thickets with the above species.

33. **Nyctanassa violacea.** Yellow-crowned Night Heron

A single specimen shot on a reef at San Benito Islands is the only record.

34. **Rallus beldingi.** Belding's Rail

None seen, but the frequent notes of Rallus heard in the mangroves at Magdalena Bay leave little doubt as to the species and its abundance.

35. **Phalaropus fulicarius.** Red Phalarope

The first of the migrating phalaropes were noted July 11, when two were seen between Ensenada and Guadalupe Island. After that date they rapidly increased in abundance until the 18th, when they seemed to be in full force. They were not seen over 50 miles off shore.

36. **Lobipes lobatus.** Northern Phalarope

Seen but once, August 2, off San Roque Island.

37. **Pisobia minutilla.** Least Sandpiper

38. **Ereunetes mauri.** Western Sandpiper

On July 26, a small flock of "sand peeps" was seen on a mudbar in the mangroves of Magdalena Bay. None was shot and positive identification was difficult. The two species usually migrate in company and it is quite probable that the flock was composed of both species. A week later we met with them migrating and in early August they were seen at all of our anchorages north of Magdalena.

39. **Limosa fedoa.** Marbled Godwit

A few were seen at San Quintin on July 21. They occur sparingly all summer in all of the suitable localities from Magdalena Bay north, the summer residents being non-breeding birds that have failed for some reason to follow the migration north.

40. **Totanus melanoleucus.** Greater Yellow-legs

Two were seen on a mudbar in the mangroves at Magdalena Bay, July 26. The one secured was in fair summer plumage.

41. **Catoptrophorus semipalmatus inornatus.** Western Willet

First seen at Abreojos Point, July 31, in a company of mixed shore-birds, evidently the first of the migrants. Quite common at San Quintin, August 14.

42. **Heteroscelus incanus.** Wandering Tattler

First seen at Guadalupe Island, July 11. While not common at this island, they were frequently seen along its rocky shores. The same may also be said of all the islands visited. Although found at all seasons of the year, those that linger through the summer are probably not nesting birds. I have found downy young seeking cover under the overhanging edges of glaciers

of the Seward Peninsula in Alaska, conditions hardly in keeping with those of the sun-scorched shores of the Lower California islands.

43. **Actitis macularia.** Spotted Sandpiper

First seen at Magdalena Bay in company with greater yellow-legs, July 26, after which they were seen at any suitable location north to San Martin Island. This species is rather common along the islands and coast of Lower California during the winter months, inhabiting rocky broken beaches in company with its larger relative, the wandering tattler. They, like the last, are seldom seen in companies of more than three or four, more often singly or in pairs.

44. **Numenius americanus.** Long-billed Curlew

Seen at San Quintin, July 18. Not uncommon at that point where, like the marbled godwit, it is a left-over from the spring migration.

45. **Numenius hudsonicus.** Hudsonian Curlew

A few found along the ocean beaches all summer, being like the above, non-breeders. This species seems to prefer the clean sands of the open beach and is not often seen on the mud-flats of the bays, where the long-bills thrive. A small flock of *hudsonicus* was seen at the entrance of San Quintin Bay, July 14.

46. **Squatarola squatarola cynosuræ.** Black-bellied Plover

A few seen among the migrating shore-birds at Abreojos Point, July 31, the first to arrive from their summer home.

47. **Oxyechus vociferus.** Killdeer

One or two noted near the settlement at the mouth of Santo Domingo Cañon, fifteen miles north of San Quintin. The species is resident in such localities, where freshwater furnishes congenial surroundings.

48. **Charadrius semipalmatus.** Semipalmated Plover

A small flock seen at Magdalena Bay, July 27.

49. **Charadrius nivosus.** Snowy Plover

A small flock seen on the beach at Abreojos Point.

50. **Arenaria interpres morinella.** Ruddy Turnstone

A flock seen at Abreojos Point. The single bird that was secured was in almost full nesting plumage.

51. **Arenaria melanocephala.** Black Turnstone

Rather common at Abreojos Point, July 31, after which it was seen on all the rocky beaches north to San Martin Island. Two were seen at Guadalupe, July 16.

52. **Hæmatopus frazari.** Frazar's Oystercatcher

Seen on all the rocky shores from the south end of Magdalena Bay north. Often seen in company with *bachmani* to which it offers a striking contrast.

53. **Hæmatopus bachmani.** Black Oystercatcher

Not seen south of Asuncion Island, where it was common. From that point north it was common on all suitable beaches.

54. **Lophortyx californica vallicola.** Valley Quail

Common in the section east of San Quintin which is the only spot visited that was suited to its requirements.

55. **Zenaidura macroura marginella.**

Western Mourning Dove

Found breeding on Cedros Island, July 22, when young just from the nest were seen.

56. **Cathartes aura septentrionalis.** Turkey Vulture

Quite common at any of the larger islands except Guadalupe and as far as Margarita Island at the southern end of Magdalena Bay.

57. **Parabuteo unicinctus harrisi.** Harris's Hawk

Seen but once, near San Quintin, where the species is not uncommon along the timbered cañons east of that point.

58. **Buteo borealis calurus.** Western Red-tail

Several were seen on Guadalupe Island and one specimen taken.

59. **Falco peregrinus anatum.** Duck Hawk

Formerly quite common, nesting on all of the islands north of Magdalena. Few were seen, however, on the voyage of the *Tecate,* due, perhaps, to the season being that when the birds might be expected to be scattered far from their nesting haunts. A fine specimen was taken on San Benito, August 13.

60. **Polyborus cheriway.** Audubon's Caracara

Seen only at Margarita Island, where it was seemingly rare. There is little doubt but the Guadalupe Caracara is extinct; no signs of it could be found by members of our party, nor have any who have visited the island during the past 20 years reported living birds.

61. **Pandion haliaëtus carolinensis.** Osprey

First seen at Guadalupe Island, where a specimen was secured. Quite common at Cedros Island and most of the stations visited. On Margarita Island there are dozens of nests built on tops, or on projecting limbs, of the giant cactus.

62. **Speotyto cunicularia hypogæa.** Burrowing Owl

Seen only at San Quintin. The burrowing owl was formerly found on the San Benitos, Natividad and other islands of the coast, where it was resident. It is possible that it has been exterminated by the cats.

63. **Geococcyx californianus.** Roadrunner

Seen only at San Quintin.

64. **Dryobates scalaris lucasanus.** San Lucas Woodpecker

This species was common, feeding on the ripe fruit of the giant cactus, on Margarita Island. Not met with elsewhere.

65. **Centurus uropygialis brewsteri.** Brewster's Woodpecker

A rather abundant species in the giant cactus growth on the west side of Margarita Island, where it was feeding on the ripe fruit of the cactus. All the specimens taken were in badly worn plumage, but indicate a strongly marked race.

66. **Chordeiles acutipennis inferior.** Texas Nighthawk

A few seen at Magdalena Bay and on Margarita Island. The single specimen taken (No. 25530 C.A.C.) agrees fairly well with skins before me, from southern California, except that it is slightly smaller.

67. **Aëronautes melanoleucus.** White-throated Swift

On the southeast side of Guadalupe Island we saw a number of these swifts cruising about the cliffs overhanging the sea. It was near this same spot that I found, in May, 1892, a nest but so far back in a crevice in the lava that without tools to enlarge the opening it could not be reached, though the sticks composing the structure could be plainly seen. On July 19 I saw several swifts in company with cliff swallows flying about a cliff at the mouth of the Santo Domingo Cañon, 15 miles

north of San Quintin. Several years ago I saw this species entering abandoned woodpecker holes in the giant cactus near San Fernando, about 75 miles south of San Quintin.

68. **Calypte anna.** Anna's Hummingbird

At the north landing on Guadalupe Island we saw a hummer in female plumage that seemed to be this species. It escaped, however, leaving its identity in doubt. W. E. Bryant recorded the species from the island many years ago.

69. **Calypte costæ.** Costa's Hummingbird

This species seemed to be the only one we met with at Magdalena Bay and Margarita Island, where several were taken in late July. Specimens were secured also at Cedros Island.

70. **Myiarchus cinerascens pertinax.**

Lower California Flycatcher

Flycatchers of the ash-throated group were seen several times on Margarita Island, but no specimens taken. I supposed them to belong to this subspecies.

71. **Sayornis sayus.** Say's Flycatcher

Common about San Quintin. On Cedros Island it was seen several times. A young male (No. 25531, C.A.S., August 8, south end Cedros Island) is somewhat darker above than specimens of similar age from southern California, with slightly narrower bill. The difference may be individual, however.

72. **Sayornis nigricans.** Black Phœbe

Seen only in the Santo Domingo Cañon near San Quintin.

73. **Otocoris alpestris actia.** California Horned Lark

The Otocoris of San Quintin. I refer to this form with some hesitation, as no additional specimens are at hand, a single juvenile in the collection of the Academy being the only

bird taken. At Abreojos Point a small flock of horned larks was seen and three badly worn and juvenile specimens secured. They seem very small and can hardly be reconciled to any of the recognized races, they being, I suppose, *enertera* Oberholser.

74. **Aphelocoma californica hypoleuca.** Xantus's Jay

A rather common inhabitant of the mangrove swamps north of the anchorage at Magdalena Bay. Not seen elsewhere.

75. **Corvus covax sinuatus.** Raven

A common species throughout the trip. Seen at every station except at Guadalupe.

76. **Carpodacus mexicanus frontalis.** House Finch

Common at San Quintin and at the nearby mission of Santo Domingo.

77. **Carpodacus amplus.** Guadalupe House Finch

Formerly one of the most abundant land birds on the island but now reduced to about 10% of its abundance 25 years ago, the destruction being due to the thousands of cats that infest all parts of the island. The species nests largely in the cactus found over most parts of the island, which fact saves the nestlings until able to flutter to the ground, where they fall an easy prey.

78. **Carpodacus mexicanus clementis.**

San Clemente House Finch

Common on Cedros Island. Five specimens were obtained.

79. **Carpodacus mcgregori.** McGregor's House Finch

A quarter of a century ago this was one of the few land species that was common on the San Benito Islands. Today they are so nearly extinct that I doubt another specimen being

taken for science. Like the last mentioned species, they have fallen victims to the cats. A single specimen was all we had to show for four guns in two days. A second specimen was reported as seen.

80. Astragalinus praltria hesperophilus.

Green-backed Goldfinch

Two females taken at the south end of Cedros Island. They seemed to be nesting in small numbers on this part of the island. Those taken are somewhat smaller than typical specimens from southern California, but whether the difference is constant will remain for further specimens to determine.

81. Passerculus beldingi. Belding Sparrow

Seen only at San Quintin, where it is common in the salt marsh.

82. Passerculus rostratus rostratus. Large-billed Sparrow

This species winters on all of the islands, I think, except Guadalupe, and had just begun to make its appearance when we noted a few along the beaches at the north end of Cedros, August 9. A single specimen was taken on San Martin Island, August 14.

83. Passerculus rostratus guttatus. San Lucas Sparrow

A few noted in the mangrove swamps of Magdalena Bay, and a single specimen taken July 26.

84. Passerculus rostratus sanctorum. San Benito Sparrow

Found only on the three islands of the San Benito group, where they are still common but greatly reduced from their former abundance. The cats are again to be given the credit.

85. **Junco insularis.** Guadalupe Junco

Becoming rare on the island, though it was at one time the most abundant species.

86. **Amphispiza bilineata deserticola.** Desert Sparrow

Common at San Quintin, Cedros and Magdalena Bay region.

87. **Amphispiza belli.** Bell's Sparrow

Common at San Quintin and San Martin Island.

88. **Pipilo crissalis senicula.** Anthony's Towhee

Common in the hills east of San Quintin. A full-fledged young was taken at the Santo Domingo Mission, July 19.

89. **Cardinalis cardinalis igneus.** San Lucas Cardinal

Rather common at "The Ranch" six miles west of the landing at Margarita Island, where the dense thickets offered congenial surroundings. Very shy and difficult to secure, one specimen only being taken.

90. **Petrochelidon lunifrons lunifrons.** Cliff Swallow

Common and nesting under the eaves of the houses at San Quintin, where nestlings were seen, July 20. On the same date a large flock was seen circulating about the face of a cliff at the mouth of the Santo Domingo Cañon. A small flock, doubtless migrating, was noted flying over the mangroves at Magdalena Bay, July 26.

LIST OF SPECIES OF MAMMALS

In the following list of mammals the nomenclature of Miller's "List of North American Land Mammals in the United States National Museum" has been followed.

As the series of Lower California mammals in the collections of the San Diego Museum of Natural History and the California Academy of Sciences are very incomplete, I have been obliged to depend in many instances on the collections in the U. S. Bureau of Biological Survey and the American Museum of Natural History, New York. My thanks are due Dr. E. W. Nelson and H. E. Anthony for comparison of several species with the types.

1. **Balænoptera physalus.** Pacific Finback Whale

Whales were often seen along the coast and about all of the islands with the exception of Guadalupe. They were nowhere common, and all that were identified with reasonable certainty were of this species. It is quite probable, however, that some seen were humpbacks.

The larger cetaceans are more abundant during the winter months in the region covered by this paper, but they were formerly far more abundant than today. In the past, when the fall migration was at its best (November) I have seen more whales in one school than were seen during the entire southern voyage. At the time mentioned, 25 years ago, the California Gray *(Rhachianectes glaucus)* was the most common species and was daily seen along shore, often inside the kelp beds, within half a mile of the beach. During the past two years I have seen just two of this species and had reports of two more, while the Sulphur Bottom *(Sibbaldius sulfureus)*, formerly quite common, has not been seen at all. The modern method of whaling has sounded the death knell. Commercial whaling is about a thing of the past and, unless something is done soon toward protecting them, several species will soon become commercially, if not actually, extinct on this coast.

Nearly all of the whales seen during the voyage of the *Tecate* were close in-shore, frequently at the edge of extensive kelp beds and, as they were usually seen in pairs, it is not un-

likely that they were mating. In late July and early August, there was a very extensive run of sardines along the entire coast and, as these small fishes furnish many of our *Balænidæ* with a large part of their feed, that may account for the entire absence of whales in deep water and their presence along the shores where the sardines abounded.

During the winter of 1920-21, a steam whaler established a station in Magdalena Bay and spent several months at that point. From the bones still to be seen on the beach, they must have killed several whales but, as they never repeated the venture, it is quite probable it was not a commercial success.

2. **Orcinus ater.** Black Killer

Killers were formerly much more common on the Lower California coast than the results of our late voyage would indicate. But one small school of seven or eight was seen several miles off San Quintin, July 18. There is no question but the killers are a bitter enemy of the entire *Balænidæ*. While I have never myself seen the species attack a whale, I have often been told by reliable authority of combats that resulted in the death of the larger "fish." It may be that the present rarity of Orcinus is directly due to the scarcity of whales. The Orca often reaches a size (twenty feet or more) equal to that of a small whale, but whalers never attempt its capture, as it is of little or no value.

3. **Grampus griseus.** Grampus

A single specimen, identified as this species, was seen off San Quintin, July 18. South of Cedros Island there were several times when large porpoises were seen, but under conditions rendering identification impossible. They may have been this species.

4. **Delphinus delphis.** Common Dolphin

On the southwest side of Cedros Island we found a well preserved skull of this species.

5. **Notiosorex crawfordi crawfordi.** Gray Shrew

A specimen taken in the edge of a salt marsh on the west side of San Quintin Bay is not separable from skins from the region of San Diego in the collection of the San Diego Society of Natural History.

6. **Pipistrellus hesperus hesperus.** Western Bat

At the anchorage at Margarita Island we met with a flight of bats at daybreak, July 28. They were seeking shelter in the ledges along the shores. Two were secured and are not to be distinguished from specimens taken at San Diego and the Colorado Desert.

7. **Canis peninsulæ.** Peninsula Coyote

Not uncommon at San Quintin, where one or two were seen. Skulls were secured at Magdalena Bay.

8. **Enhydra lutris nereis.** Southern Sea Otter

Formerly very abundant on the coast of Lower California, as far south at least as Natividad Island. The early records abound in stories of the numbers of sea otter found along this coast where, alas, they were soon exterminated, or at least so reduced that they became almost a myth.

In 1807 the ship *Dromio* from Boston is recorded as trading for 1700 otter skins at Ensenada, then inhabited by a few Indians who must have taken the animals along the kelp beds adjacent to that bay. Capt. Benjamin Morrel in 1825-31 made four voyages to this coast from the Atlantic and mentions "immense numbers of whales, seals, and otters at San Quintin and Cenizas (San Martin) Island."

In 1887 when I first became acquainted with the region of Todos Santos Bay and the former haunts of the sea otter, they were generally considered as extinct. There were, however, a few of the old-time hunters that assured me that in the region of certain kelp beds south of Ensenada there were a few to be found. This, I learned, was true, and a small colony was

established that by now might have been of large commercial importance had it been protected. Unfortunately, it was discovered by certain "beach combers" in 1897, and to the best of my information some 50 were killed. There is a report of 28 being killed eight or nine years later at the same point, but I am unable to authenticate it. That a few still exist, as far south as Cedros, there can be little doubt, as one was killed by a fisherman in 1919, at San Benito Island 15 miles west of Cedros. They were formerly abundant along the kelp beds found along the weather side of Cedros and the Benitos, and in time may be re-established there, if unmolested.

9. **Zalophus californianus.** California Sea Lion

An abundant species on most of the islands visited except Guadalupe, where one rookery of a dozen was found and a few scattered individuals along the shores that might have made the Guadalupe count as much as 50 animals. They were about abandoning the breeding rookeries in August so that a census of the various colonies was out of the question, but from what we found I would place the present count of sea lions, of the coast of Lower California, at fully 150% above what might have been found in 1900. At the last date the species was being persecuted for hides, the rookeries being raided constantly during the season of reproduction. Frequently hundreds of young were left to starve beside the bodies of the slain mothers. At Asuncion Island in 1898, I found a rookery of not over 50. The count at this island in August, 1922, was over 5,000. As San Roque Island, only six miles north of Asuncion, was almost deserted by Zalophus, it is quite probable that Asuncion was being used as a hauling ground for sea lions from both islands.

At Cedros Island there were several large rookeries, but at the time of our visit the animals had begun to scatter and it was not possible to secure a census. I had confidently expected to find at the north end of this island the star sea lion rookery of the coast, as that was its condition in 1898 when it was populated by some 2,000 breeding animals. At the time of our visit, August 9, there were 1,500 Zalophus hauled on the sand

beach at the north bay and some 700 on a beach about two miles south. On the east side of the island two detached rocks formed ideal resorts for sea lions, but we found only 300 at this point. San Benito Islands, where Townsend, in his report of the Albatross Expedition in 1911, mentions finding 1,700 Zalophus, gave us not over 400.

We frequently met with sea lions many miles from the known hauling grounds and far from land, indicating a scattered condition quite different from what would be found in April when a large percentage would be collected on the breeding rookeries. On the Lower California islands the pups are born about June 10, and are about six weeks or two months old before they go into the water, though a young sea lion a week old can and will swim if forced to do so. A baby sea lion spends a large part of its early life in sleep, which is surprisingly difficult to disturb. The present writer has, on several occasions, visited a rookery where the beach was strewn with sleeping pups, seated himself among them and gathered one or two into his lap, and played with them for several minutes before they were sufficiently aroused to realize the true situation. Their surprise was always laughable, as they voiced a horrified baby imitation of daddy's roar and perhaps made a bluff at amputating a human hand or two. A newly-born sea lion is possessed of a full set of needle-like teeth and ample strength to make them serviceable, but, of the many that have by their actions promised to seriously mutilate me, none has yet drawn blood, and such fierce savage beasts have, after a ten-minutes' fondling, refused to be left alone and frequently followed, bawling, along the sand, as if they were losing their best friend.

In this connection might be mentioned an incident in which a sea lion figured, which illustrates the confiding nature of the animal when it is not persecuted. In April, 1922, a seaplane from the North Island Aviation Field made a landing at sea about 30 miles from the Coronado Islands and about the same distance from the mainland. Shortly after the plane came to rest, the pilot heard a scratching on the side of the machine and looking over saw a yearling sea lion investigating the strange craft. The door to the cockpit was held open and the invitation promptly accepted, the seal returning to San Diego by air-

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plane. I visited the station a few days later and found the visitor to be a yearling female and as eager to be noticed as any pet kitten. Though given the freedom of the bay, it always returned to its new home on being called and never at any time showed any disposition to return to the company of its fellow lions.

10. **Arctocephalus townsendi.** Guadalupe Fur Seal

That fur seals of some species were at one time abundant on most, if not all, of the islands of the peninsula, as well as those of California, cannot be disputed. There are undoubted records of many thousands of skins being taken from the Farallons and the islands south to Cape St. Lucas. At this time it is largely a matter of conjecture as to even the genus. During the fur seal controversy between England and the United States in 1892, Dr. Charles H. Townsend and the present writer visited Guadalupe Island in the hope of securing specimens of the fur seal said to have once existed there. The net result of our trip was four more or less broken skulls upon which was based a genus and species new to North America, *Arctocephalus townsendi.* In Dr. Townsend's report he mentions several living specimens as being seen but not taken. In the light of recent events, I have some doubts as to the animals seen were really fur seals; they may have been young California sea lions. The yearling Zalophus is quite easily mistaken under conditions such as we encountered, and though we may have seen Arctocephalus it is by no means certain. However, in 1893, there were said to have been 35 fur seals killed on Guadalupe and 15 the year following, the last being the final record, so far as I know, although I am of the opinion that a few were taken from year to year for some time. One of the chief objects of the voyage of the *Tecate* in 1922 was to secure all evidence possible as to the fur seal in the past and to ascertain if living animals were to be found.

On July 16 we examined the old rookery at Jacks Bay on the weather (west) side of the island, where the skulls of Arctocephalus were found in 1892. At this point we found a remarkably well defined rookery, marked by well polished rocks,

that at one time accommodated fully 30,000 adult seals. As is well known to those familiar with the habits of fur seals, they restrict themselves to certain limits, preferably a boulder-strewn beach, where in time—hundreds of generations perhaps—the rocks become polished and the rookery limits defined as sharply as if painted. A short distance inland from the rookery are eight stone huts, four of which were seemingly for storehouses and four for living quarters. The walls only are left, and it is evident that the roofs were of canvas or hides. Still further inland is an extensive area of land cleared of stones and, leading to it from the rookery, a walled driveway, the walls being of stones and palm logs—the cleared space being the killing and skinning grounds.

From the evidence obtainable, this was the work of Russians, who came from the north with Aleuts not less than 125 years ago. Not a bone or fragment is left of the many thousands of fur seals killed there in the past. At the south end of Guadalupe is a still larger rookery, estimated to have been populated by 30,000 or more. Here, as at Jacks Bay, are a number of stone walls marking the sites of storehouses and living quarters. On the beach above the rookery, the cleared area is marked by thousands of wooden pegs once in use to hold the skin stretched until dry enough to store for shipment. Many of the pegs today mark the outlines of what was a seal skin over 100 years ago, and so kindly have the elements treated the wood that there is scarcely any decay, but here, as at the northern rookery, no bones of Arctocephalus were found. A somewhat smaller fur seal rookery was found on the east side of the island, and it was estimated that at one time Guadalupe was populated by at least 100,000 fur seals, old and young.

I have knowledge of two fur seals being shot on the west San Benito in about the year 1890.

While the Guadalupe Fur Seal was resident to a far greater degree than its northern relative, there were periods each year for some two or three months when it left the islands and disappeared. Where it went the hunters were unable to tell me, nor can I even say at what time of the year it migrated. During a large part of the time it was found about the island. It inhabited the many caves found here, and there is a chance that

some such cave dwellers may have been overlooked at the time we were exploring the islands.

I find among the early records of the islands some very interesting notes on the fur seal, as the log of the *Port au Prince,* a whaler that sailed from England, February 12, 1805, and touched at Cedros for a cargo of elephant seal oil. Leaving Cedros on August 23, she proceeded to the Benitos 15 miles west, where in 19 days, 8,338 fur seals were killed. The ship *Dromio,* out of Boston, arrived at "Shelvrocks Island" (Socorro) in November, 1808, and in two weeks killed 3,000 fur seals. Another early navigator states that as he found the northern islands—Santa Barbara Islands and those of Lower California—being sealed by the Russians, he proceeded to Socorro where, in a day's search he saw some 20 fur seals and 1,500 sea lions. The fur seal outlook not being inviting, the ship did not engage in that trade.

The fur seals of Guadalupe must have been commercially exterminated by the Russians early in the last century, for nothing seemed to have been known of them during the American occupation of California until about 1876, when they were accidentally discovered by a schooner from San Diego, and for a short time a profitable trade was enjoyed by a number of small craft. The curtain was rung down on the last act in 1894, when 15 were said to be the season's catch. We have authentic records of 5,575 being killed at Guadalupe and San Benito between 1876 and 1894. Whether there will be others in the years to come remains to be seen.

11. **Phoca richardii geronimensis.**

San Geronimo Harbor Seal

This species never was very abundant on the coast of Lower California, but a few were seen on the sand bars in San Quintin Bay. On San Roque Island, August 2, there were a dozen or more on the rocks. They seem to avoid the company of other species, and are more at home on the sand bars and mud flats of enclosed waters than the rocky shores and surf that seem to suit the requirements of Zalophus.

12. **Macrorhinus angustirostris.** Elephant Seal

The history of this most interesting species is filled with tragedy. Once it was abundant from the region of Santa Barbara to Magdalena Bay, some 800 miles of coast line. It became so reduced in numbers, due to extensive slaughter on the part of the early whalers who killed the animal for the oil, that as long ago as 1869, Scammon regarded it as "nearly, if not quite, extinct." Since that day naturalists have several times unexpectedly encountered a small family and, in killing them, have secured for science what they honestly looked upon as the last of the species. Although the taking of these last survivors was regarded as regrettable in the extreme, it was considered justified, on the grounds that the species was doomed to die at the hands of whalers or sealers, and museums were in need of the specimens.

The present condition of the remnant of the once abundant species speaks volumes for its ability to rebuild, if given opportunity. In 1911, Charles H. Townsend found 150 on the west side of Guadalupe, at the same hauling grounds where he and the present writer found nine in 1892,—of which seven were killed for the National Museum at Washington. On the return of Dr. Townsend's expedition, the newspapers of the coast featured the rediscovery of this strange creature in such manner that the public was led to think that the capture of one meant an independent fortune for the captor, and as a result to be expected the fishermen of southern California flocked to the spot to reap the harvest. It would be impossible to state how many were killed, but they were numerous and, needless to state, the specimens thus killed were of no value to museums. The Mexican Government, at this stage of the game, placed an embargo on the killing of elephant seals, and, for a time at least, the few living were given a respite.

In the winter of 1920-21, an enterprising whaler, hearing of the occurrence of the species on the coast of Lower California, outfitted for a cruise that was intended to bring their history to an end. · Fortunately, however, it was supposed that the elephant seals were in the Gulf of California. Guadalupe

Island was not visited, and the voyage, from a commercial point, was a failure.

About the time plans were being made for the total extermination of this species by way of the whaler's try-pot, a company operating a fertilizer plant in California applied to Dr. Hanna, of the California Academy of Sciences, for information as to the whereabouts of the sea elephants, stating they wanted to use what were left for a few days' run of their plant. Needless to state, the information was not given, and while some cabbage field may have lost a temporary stimulant, the elephants were given another reprieve. In July, when the Guadalupe elephant beach was visited by our expedition, we found 264 animals hauled on the sand, 14 of which seemed to be young of the year and presumably there was an equal number of mothers. While the adult animals are quite fearless, even almost impossible to disturb to the extent of causing them to leave the beach, the pups were rather timid and before the disparity of sexes was noticed all the pups had gone to sea, and with them the females, leaving only the bulls to interview the intruding naturalists. At this date (July 12) the younger animals had seemingly finished the moult and were in a dark gray or blackish coat,—black when first emerging from the water. Most of the larger bulls were in a tattered, ragged condition, indicating the extreme moult, the neck and anterior parts of the body being hung with streamers of cuticle and hair, oftentimes several inches in length, hanging from pink or flesh-colored undersurface, suggesting a bad case of sunburn.

In moulting, not only is the hair renewed but the entire cuticle seems to be shed, the beach being strewn with patches of the old coat oftentimes as large as a man's hand. On examination of these detached patches of cuticle and pelage, it is difficult to tell at a glance which was the inner side, the hair extending 3 mm. beyond the cuticle on its inner surface and 10 mm. for the exterior measurement. The color is somewhat lighter on the flesh side as well. These animals with the old moulting coats were more or less uniform yellowish-tan, or what is generally recognized in the West as "buckskin" color, contrasting strongly with the darker—almost black—coats of

the younger males that had completed the moult. The pups that we assumed to be of the current year were about 175 pounds in weight, dark gray above, with an obscure mottling of the coat in certain lights, suggestive of the spots in the coloring of *Phoca richardii,* the upper coloring gradually fading to a very light gray—almost white—below.

A yearling size juvenile was estimated to be of about 500 pounds weight and, like the adults, uniform dark gray. In the adult female the coloring is similar, the only difference being in the almost total lack of the nasal development so characteristic of the adult male. In this respect they resemble quite closely the undeveloped males. A male elephant seal was shot for the Mexican collections and, though several shots were required to dispatch the animal, those 10 feet distant paid little or no attention to the disturbance. The stomach contents of this animal was a small amount of the volcanic sand of which the beach is composed.

In 1892 I found sand and pebbles the size of hens' eggs in the stomachs of those taken for the National Museum, and in only one was there any indication of the food—a fish, Sebastodes(?), of about one and one-half pounds, together with a few fronds of kelp that were doubtless unintentionally taken along with the fish, was taken from the stomach of one young male.

Before landing, the animals spend some time along the surf and it is quite possible that digestion is complete before they land. The stones and sand are no doubt taken from time to time in capturing their finny prey, and is not in any manner intentional. Similar matter has been reported as found in the stomachs of sea lions and fur seals, and has been mentioned as "ballast" that is taken by the seal before going into the water,—a story that should be classed with that of the hoop-snake.

An alarmed elephant seal will often "back up" at a pace exceeding that usually shown in advancing. This is accomplished by repeated, sudden jerking of the hind flippers and posterior part of the body, and is suggestive of the progress of a freshly

captured lobster. At times they will back down the beach and into the surf in this manner rather than turn and perhaps lose sight of the object that threatens. Upon coming out of the water, the adults leisurely crawled up to a point well above the tide, frequently pausing to rest, as if the effort were considerable. No use is made of the posterior limbs, the body being laboriously dragged along by action of the short but very powerful front flippers and the muscles of the abdomen, somewhat as an "inch worm" progresses. Finding a spot suited to its ideals, the animal usually proceeds to pitch sand over its back, using the front flippers as shovels until the upper parts are well sanded. The same shovels and lava sand also come in play as means of defence, for on several occasions when an animal was disturbed by members of our party a discharge of sand, sent with almost the force of bird shot, caused a hasty withdrawal. It was quite evident that the barrage was intended as a defence, for while the sand intended as a covering for the back is always tossed six or eight feet in the air, to land largely on the animal, when intended for the face of a man it was shot backward at a low angle, the seal looking back over the shoulder to note the effect and turning with surprising quickness to keep the intruder in range of its artillery.

The adult males are somewhat quarrelsome and, to judge by the battle-scarred necks and shoulders, indulge in some combats that are decidedly sanguinary. At the time of our visit, however, an armistice had been declared. Two bulls meeting often snapped at each other, raising the heads to a surprising height — eight feet or more, — mouth open and attitude threatening in the extreme, and such battles resulted in more threats. When challenging, the bulls often curved the flexible proboscis over into the wide open mouth until it must have been nearly at the base of the tongue. At such times they gave voice to the only sound I have heard, a loud gurgling roar, that might be compared to a much magnified snore. I have heard this note when half a mile or more from the animal. At times, also, the trunk is elevated and recurved until it points almost backward. At rest and in its normal position, it is withdrawn until it overhangs the mouth but little and rests

in two or three grotesque folds, extending back nearly to the eyes.

Estimating the number of female and immature elephant seals on the basis of the adult males we found on the beach in July, the entire Guadalupe herd should easily be 1,000 animals. There were over 300 adult males on the main beach on our return, July 16, and at the entrance to a large cave north of the beach we found 36 more, all males. The cave being all but closed by the high tide, we were unable to ascertain what might be inside. The Mexicans, however, on a subsequent visit to the island early in September, found "150 females and an equal number of pups about thirty inches in length inside the cave." If this information regarding the young is correct, those which we saw in July and considered as young of the year were about ten months old—as the pups of the California sea lion, Zalophus, are fully 30 inches in length at birth. There would seem to be something further needed in way of data before we definitely state that the animals seen were in fact Macrorhinus.

Several years ago there were a number of elephant seals captured at Guadalupe and taken to one of the amusement piers near Los Angeles, where for a time they were on exhibition. A storm destroyed the pier and the seals escaped. On two or three occasions the species has been reported from different points along the Santa Barbara Channel, and it is quite probable that it is the escapes that were seen. There may perhaps be a small breeding herd established at some of the outlying islands which, if protected, will in time re-establish the species in its old-time haunts among these islands.

For several years past a few elephant seals have been seen about the San Benito Islands, but it is certain that no colony has yet been established there. They have been seen in May and October and in sufficient numbers to indicate that more than a mere few might have wandered from the main herd. They no doubt in due time, if the present protection is enforced, will regain their lost rookeries on San Benito and Cedros. We found a number of badly weathered skulls on each of the above mentioned islands, where the whalers of 50 years or more ago had killed the animals for their oil.

The Mexican Government has recently designated both Guadalupe and Cedros islands as animal refuges, with a very heavy penalty for any infraction of the law. If the regulations are enforced, there is no doubt but the present species, as well as others, the future of which is in danger, may enjoy many more years of existence.

13. **Peromyscus eremicus cedrosensis.**

Cedros Island White-footed Mouse

Specimens are in the collections from each of the five stations made on Cedros Island. The species seemed to be rare in the interior, but very common along the beaches.

14. **Peromyscus eremicus polypolius (?)**

Margarita White-footed Mouse

Several Peromyscus were taken on Margarita Island, but all were so badly mutilated by ants that little could be learned of the external appearance. One specimen was seemingly of an almost uniform ashy or pearl gray, lighter below,—perhaps an albino.

15. **Peromyscus maniculatus sonoriensis.**

Sonoran White-footed Mouse

It is with some hesitation that I refer a single Peromyscus from San Quintin to this race. The specimen is immature and agrees in a general way with specimens from southern California of similar age, but the tail is much more sharply bicolor and the lower parts more decidedly white than any in the collection of the San Diego Society of Natural History.

16. **Peromyscus maniculatus coolidgei.**

Coolidge White-footed Mouse

At San Bartolome Bay two specimens were taken.

17. **Peromyscus maniculatus geronimensis.**

Ashy-gray White-footed Mouse

Very abundant on Natividad Island, the only station in its habitat at which we touched.

18. **Peromyscus maniculatus cineritius.**

San Roque White-footed Mouse

Very abundant on Asuncion Island. San Roque Island, the type locality of this subspecies, is but six or seven miles from Asuncion and with exactly similar conditions and environment. No traps were set on San Roque, so I am unable to make a direct comparison with specimens from that island. Specimens were sent to the American Museum of Natural History and compared with types by my son, H. E. Anthony, who states:

"Very close to *cineritius* of San Roque; belly a trifle whiter, hind feet seeming to lack dusky ankles of San Roque series. It is possible that the Asuncion animal is a slightly characterized subspecies of *maniculatus* distinct from *cineritius*, but a larger series of specimens from Asuncion as well as from San Roque is needed to establish this point. No apparent skull differences."

19. **Peromyscus maniculatus magdalenæ.**

Magdalena White-footed Mouse

Common on Magdalena Island.

20. **Neotoma intermedia intermedia.**

Intermediate Wood Rat

Common about San Quintin Bay.

21. **Neotoma intermedia pretiosa.**

Matancita Wood Rat

Quite common on both Magdalena and Margarita islands.

22. Neotoma bryanti.

Cedros Island Wood Rat

Neotoma were found more or less abundantly in all parts of Cedros Island, more common in the northern end and among the more broken parts of the island and rather scarce at the south end, where the land is lower and less suited to their requirements.

23. Epimys rattus alexandrinus.

Roof Rat

A specimen taken on the west side of San Quintin Bay opposite the settlement. At some time within the past two years a large steamer was wrecked on San Roque Island, evidently introducing rats at that point, as a dead Epimys was seen on the beach.

24. Mus musculus musculus.

House Mouse

Mice of this genus are more or less distributed over Guadalupe Island and, as they are more abundant in the sections adjacent to the fur-seal rookeries, it is not improbable that they were introduced by the Russians a century or more ago. A single immature mouse was shot at Jacks Bay on the west side of the island. If this specimen represents the normal color of the race at present found on Guadalupe, it is a very interesting illustration of evolution. The upper parts are a rich brown, several shades darker than any specimen in the collection of the San Diego Museum of Natural History; below, somewhat lighter. It will be better, however, to await further specimens before separating the race.

25. Perognathus helleri.

Heller's Pocket Mouse

The type of this species was taken at San Quintin, where pocket mice are quite common. For some reason they were

very hard to trap at the time of our visit, and but two were secured, both from the west side of the bay.

26. Perognathus penicillatus albulus.

Magdalena Island Pocket Mouse

At Magdalena Bay we found this race not uncommon, but owing to the ants destroying the specimens only two were secured in condition worth saving.

27. Perognathus anthonyi.

Anthony's Pocket Mouse

For the past quarter of a century this species has been represented by the single type in the collection of the Biological Survey, collected by the present writer at South Bay, Cedros Island. During the summer of 1922 we found the species rather commonly distributed over the island, from the sandy arroyos at the beach to the rocky hillsides nearly or quite, to the tops of the higher mountains. For some reason, this species was very difficult to secure in traps and only six specimens were taken. The series, however, shows a very interesting condition of moult, which is perhaps best expressed in Dr. Nelson's letter regarding the series:

"The specimens of Perognathus from Cedros Island have been compared with the type taken by you at South Bay many years ago. One of these from the west side of Cedros Island, like the others from South Bay, agrees closely with the type. These specimens in fresh pelage are, however, nearly throughout more blackish, less brownish, than the type, which is in a worn and somewhat faded pelage. In one of your examples, however, the pelage change is evidently progressive, beginning on the anterior part of the body. The brownish rump and hind legs still in worn pelage very closely resemble the faded pelage of the type, showing that the apparent difference in general color is only seasonal. These specimens of *Perognathus anthonyi* are of considerable interest, as, up to the time of this second collection, the type had remained unique."

The work of this species so closely resembles the hills that mark the burrows of Thomomys that for many years I have felt certain that there was a species of that genus to be found on Cedros Island. Dr. Hanna, though experienced in collecting pocket gophers, was also misled by the many "dumps" along the gulches and it was not until we had dug into several of the burrows and unearthed a pocket mouse that we reluctantly agreed that we had been deceived.

28. Dipodomys merriami parvus.

San Bernardino Kangaroo Rat

Not uncommon at San Quintin. Three specimens.

29. Dipodomys platycephalus.

One night was devoted to the traps at Abreojos Point, but, though signs of Dipodomys were noted in several places, no specimens were taken. An owl pellet, which was found near the beach, contained the skull and bones of the above species.

30. Ammospermophilus leucurus peninsulæ.

Lower California Ground Squirrel

Common on the plain east of San Quintin, where two were secured, July 20.

31. Lepus californicus martirensis.

San Pedro Martir Jack Rabbit

Two jack rabbits taken at San Quintin in July are somewhat puzzling. If one is to judge from the coloring as given in Nelson's "Rabbits of North America," they would be classed as *martirensis,* to which form I have provisionally assigned them; though the measurements agree more closely to those of *bennettii.*

32. **Lepus californicus magdalenæ.**

Magdalena Island Jack Rabbit

On the west side of Margarita Island we found this strongly marked race rather common, but not easily collected owing to its keeping largely in the thick growth of underbrush found along this side of the island. A half-grown young was shot July 29.

33. **Sylvilagus bachmani cinerascens.**

Ash-colored Cottontail

A single specimen of the brush rabbit from San Quintin I have regarded as this race. There is nothing to distinguish it from specimens taken at San Diego, either in color or measurements, though the locality is well within the range of *exiguus* and considerably south of recorded capture of *cinerascens*.

34. **Sylvilagus bachmani cerrosensis.**

Cedros Island Cottontail

Two specimens of this species were secured from Cedros Island.

35. **Odocoileus cerrosensis.**

Cedros Island White-tailed Deer

We found this deer fairly common on Cedros Island, though since its discovery a quarter of a century ago it has been reduced to the point of extinction by mining operators that depended upon venison to furnish meat the year round for a large force of workmen. The last company working the mines at the north end of Cedros is said to have left several dogs that have multipled until at this date several large packs are roaming the island and killing many does and fawns. In August we secured several specimens and saw others.

36. Antilocapra americana peninsularis.

Lower California Antelope

Formerly quite abundant from San Quintin south to Turtle Bay, but reduced at this writing to but a remnant of its former numbers, due chiefly to hunters hired by American corporations operating mines and quarries within the range of the species. The only evidence we found was a horn, from a recently killed animal, at Abreojos Point.

PROCEEDINGS

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XIV
EXPEDITION TO GUADALUPE ISLAND, MEXICO, IN 1922[1]

THE COLEOPTERA

BY

FRANK E. BLAISDELL, SR.

This report covers the Coleoptera taken by the expedition of the California Academy of Sciences to Guadalupe and other islands off the west coast of Lower California in July and August, 1922. This expedition was made possible through the courtesy of the Mexican Government, which placed its fisheries patrol boat *Tecate* at the services of the Academy and the San Diego Society of Natural History and collaborated with those institutions in the work of the expedition. No entomologist accompanied the party, but a very good series of insects was secured through the efforts of Dr. G. Dallas Hanna and Mr. Joseph R. Slevin, who devoted as much time to this work as they could spare from their other duties. The fact that 14 new species and a good series of other rare beetles were taken fully justifies the effort made.

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[1]This paper is No. 3 of the Tecate expedition. No. 1, the Narative, gives a complete itinerary. See this volume, pp. 217-275.

LIST OF THE SPECIES TAKEN

1. **Cicindela latisignata** Lec.

One female at San Quintin, July 19, by Dr. Hanna. The legs and propleura rather more coppery than usual.

2. **Cicindela hæmorrhagica** Lec.

A series of nine specimens taken at San Quintin, July 19, Magdalena Bay July 26, and Cedros Island August 7, by Dr. Hanna.

3. **Cicindela sigmoidea** Lec.

Nine specimens were secured at San Quintin, July 19, by Dr. Hanna.

4. **Calosoma semilæve** Lec.

Two good specimens and one badly damaged specimen were collected at San Quintin, July 20, and on Guadalupe Island, July 13 and 15, by Dr. Hanna.

5. **Celia californica** Dej.

A moderate series was taken on Guadalupe Island, July 13 and 15, by Dr. Hanna.

6. **Amara insignis** Dej.

A small series obtained on Guadalupe Island, July 13 and 15, by Dr. Hanna.

7. **Calathus obscurus** Lec.

Three specimens were taken on the main land at San Quintin, Lower California, on July 19, by Dr. Hanna.

8. **Calathus guadalupensis** Casey

A fine series of this large species was taken on Guadalupe Island, July 13 and 15, by Dr. Hanna.

9. **Platynus (Leucagonum) guadalupense** Casey

In this species the body is more abbreviated than in *maculicollis* Dej. Three specimens. Guadalupe Island, July 15, by Dr. Hanna.

10. **Pinacodera semisulcata** Horn

A moderately large series of this species was secured on Asuncion Island, August 1, by Dr. Hanna.

11. **Pinacodera sulcipennis** Horn

Three specimens were taken by Dr. Hanna at San Quintin, July 19.

12. **Dicheirus piceus** Mén.

Guadalupe Island, July 14, N. E. Landing. One specimen secured by Dr. Hanna.

13. **Anisotarsus flebilis** Lec.

A single example of this species was found on Guadalupe Island, July 17, by Mr. Slevin.

14. **Creophilus villosus** Grav.

A single example of this common and widely distributed species was taken on Guadalupe Island, July 15, by Mr. Slevin.

15. **Trichochroüs margaritæ** Blaisdell, new species

Form parallel to slightly oblong-ovate and moderately convex. Lustre dull. Color nigro-piceous; legs bright rufous; antennæ more or less

rufo-piceous distally, toward base rufous; first joint usually rufo-piceous; terminal two joints of the maxillary palpi blackish at apex; mouth parts more or less pale, labrum rufous; elytra at apex more or less obscurely reddish.

Pubescence slightly squamiform above, dense, short, recumbent, with no evidence of longer intermixed hairs; color ashy. Lateral pronotal and elytral fimbriæ moderately short, not very closely placed. Body beneath with finer, longer and more sparsely placed hairs.

Head relatively small, subtriangular, muzzle short; front scarcely impressed, punctures fine and not crowded. Eyes prominent. Antennæ moderately stout and extending length of terminal joint beyond pronotal base.

Pronotum about a fourth to a third wider than long; apex truncate in moderate circular arc; apical angles obtusely rounded; sides scarcely subangulately arcuate just behind middle at point of greatest width, thence feebly arcuate and converging to apex and base; base broadly arcuate with the angles broadly rounded; disk rather strongly and evenly convex; punctures fine and not dense.

Elytra about twice as long as wide, moderately and evenly convex; sides parallel, punctures fine and not dense. Abdomen finely and rather densely punctate.

Male: Narrower and more parallel. Fifth ventral truncato-sinuate.
Female: Rather more oblong-ovate, and a little wider; fifth ventral rather subangulately arcuate at apex.

Length (types) 1.6-2.4 mm.; width .8-1 mm.

Type: Male, No. 1676, and *allotype*, female, No. 1677, Mus. Calif. Acad. Sci., collected by Dr. G. D. Hanna, July 29, 1922, on **Santa Margarita Island.** Paratypes in the collection of the Academy and in that of the author.

According to Casey's table of species, *margaritæ* falls near *innocens* Casey and *apicalis* Casey. *Innocens* is more elongate with less dense and pale fulvous pubescence. In *apicalis* the pronotum is transversely oval and the body stouter, with the elytra more widely testaceous at apex. A series of 15 specimens has been studied.

16. **Necrobia rufipes** De G.

One specimen of this cosmopolitan species taken on Guadalupe Island, July 11, by Dr. Hanna.

17. **Nemognatha insularis** Blaisdell, new species

Form elongate. Color fulvous throughout, except the antennæ, tips of femora, tibiæ and tarsi, which are deep black. Surface sparsely clothed with short and nearly erect black hairs, those of the under parts longer. Head finely and rather thickly punctate; eyes oblong-oval, slightly sinuate anteriorly; maxillæ slender, moderately short, attaining base of metasternum when the head is flexed against the prosternum; antennæ extending to about middle of elytra.

Pronotum subquadrate, slightly widest in anterior third, angles rounded; apex rather arcuate, feebly sinuate in middle third; sides feebly arcuate, slightly convergent posteriorly; base arcuate; disc moderately and quite evenly convex, very finely and not densely punctate. Elytra finely and not very closely punctate. Spurs of the metatibiæ, equal and slender.

Male: Abdomen with sparsely placed and rather long black hairs; fourth and fifth segments with median tufts of pale hairs; sixth segment apparently impressed and deeply emarginate, emargination triangular and about twice as deep as wide at base.

Length (types) 7.5-9 mm.; width 2-2.4 mm.

Insularis approaches nearest to an unnamed Sierran species. It should follow *scutellaris* Lec. in our lists.

Type: Male, No. 1678, and *allotype,* female, No. 1679, Mus. Calif. Acad. Sci., collected by Dr. G. D. Hanna, August 4, 1922, at **Bernstein's Spring, on Cedros Island.** *Paratype,* one male in collection of the author.

18. **Buprestis aurulenta** L.

One specimen taken on Guadalupe Island, July 15, by Dr. Hanna.

19. **Agrilus blandus** Horn

One specimen taken on Cedros Island by Dr. Hanna.

20. **Dermestes vulpinus** Fab.

A moderate series was taken by Dr. Hanna at the following places: Asuncion Island, August 1; San Roque Island, August 2; Abreojos Point, July 31.

September 5, 1925

21. **Rhagodera laticeps** Blaisdell, new species

Form elongate, a little more than three times as long as wide, slightly wider posteriorly and moderately convex. Color nigro-piceous and usually more or less covered by a grayish coating.

Head nearly quadrate, slightly dilated anteriorly and coarsely punctate; front with or without impressions, when distinct noticeable along the frontal suture, on vertex and broadly and feebly within the eyes; superciliary ridge acute but not raised above the eyes as in *costata;* sides of front obliquely emarginate at oblique suture.

Pronotum broader than long, sides arcuate anteriorly, becoming broadly sinuate, convergent, straight or parallel to base, where the angles are subrectangular and slightly prominent posteriorly; sides feebly denticulate; disk strongly bicostate, costæ scarcely arcuate and parallel.

Elytra oblong, slightly widest behind; humeri subrectangular; sutural, marginal and the discal costæ entire and subacutely elevated; intervals with two rows of large, coarse, but not strongly impressed punctures. Body clothed with short scale-like hairs.

Length (type) 7.5 mm.; width 2.4 mm.

Type: Female, No. 1680, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 13, 1922, on **San Benito Island.** *Paratypes,* 12 females in the Academy collection and in that of the author.

R. laticeps varies in size just as *tuberculatus* does; it is no larger and is distinct from both that species and *costatus.* Horn's description of *costatus* is too meager and unsatisfactory; he states that it is more depressed than *tuberculatus,* with all the costæ more prominent and with deeper interstitial punctures. This is not so with *laticeps,* for the costæ and interstitial punctures are less strongly marked, the elytra are widest behind the middle; the basal angles of the pronotum are really a little more than rectangular, but I do not consider them acute and posteriorly produced as Horn states of *costatus.*

R. laticeps is much less rough and less strongly sculptured than *tuberculatus.* From Horn's description I drew the inference that *costatus* is as strongly or more strongly sculptured than *tuberculatus.*

22. **Melanophthalma distinguenda** Com.

Four specimens, all taken at N. E. Landing on Guadalupe Island, July 11, by Hanna and Slevin.

23. **Scymnus guadalupensis** Blaisdell, new species

Form moderately broadly oval, slightly narrowed anteriorly. Abdominal post-coxal arc normal, not quite attaining the apical margin of first segment, arcuate throughout, curving forward externally and attaining the basal margin of the segment. Prosternum rather wide and feebly convex between the coxæ; carinæ feeble and converging slightly anteriorly, entire, intervening surface glabrous. Body bicolored, pale above and somewhat nubilate. Pubescence sparse, short, pale flavate in color and irregularly directed. Color beneath deep black; legs rather dark luteo-flavate; head, pronotum and elytra, more or less castaneous.

Head piceo-castaneous, front plane, finely and sparsely punctate.

Pronotum transverse, sides discontinuous with those of the elytra, feebly arcuate and parallel; base lobed at middle third, thence obliquely and very feebly arcuate; disk blackish in central and basal two-thirds and narrowly so along the apical margin behind the head, punctures sparse and slightly coarse.

Elytra narrowly black on the sutural margins, and very indefinitely clouded on each elytron near the base; punctures scarcely coarse and sparsely placed, finer along the suture. Scutellum black. Beneath densely and rather coarsely punctate, including the post-coxal plate.

Length 2 mm.; width 1.5 mm.

Type: No. 1681, Mus. Calif. Acad. Sci., collected by Mr. Slevin, July 17, 1922, at the **South Anchorage, Guadalupe Island.**

Fall, in his "List of the Coleoptera of the Southern California Islands," does not mention a single species of Scymnus as having been taken on Guadalupe Island. The single specimen at hand is well preserved and surely does not agree with anything mentioned by Casey in his "Revision of the American Coccinellidæ, nor apparently with any species given in the Biologia.

S. guadalupensis resembles *nebulosus* at first sight. Its color is darker, the post-coxal lines are complete, the prosternum is less convex and the carinæ feeble and more widely separated, with the intervening surface glabrous. In *nebulosus* the post-coxal lines are incomplete, the prosternum more convex, carinæ stronger and more evidently converging anteriorly with the intervening space narrower.

24. **Coccinella californica** Mann.

Nineteen specimens. Guadalupe Island, July 11-15, collected by Hanna and Slevin.

25. **Exochomus fasciatus** Casey

One specimen was secured at each of the following places: San Quintin, July 19; Natividad Island, August 3; Santa Margarita Island, July 29; all by Dr. Hanna.

26. **Cistelid**, undetermined species

27. **Cryptadius inflatus** Lec.

Seven specimens, Natividad Island, August 3; Asuncion Island; Angulo Rock, August 1; San Roque Island, August 2; secured by Hanna and Slevin.

28. **Stibia williamsi** Blaisdell, new species

Form ovate, about twice as long as wide, elytra somewhat inflated, strongly convex. Color dark nigro-piceous; legs and antennæ slightly rufo-piceous; surface shining and glabrous, head and pronotum slightly duller.

Head rather coarsely and confluently punctate; deflexed epistomal lobe triangular, line forming the upper margin of the deflexed portion not strong and, as usual, continuous with the sides of the front when viewed from above; mandibular tooth subapical. Antennæ long and slender, tenth joint attaining pronotal base.

Pronotum transverse and moderately convex; apex truncate in moderate circular arc; apical angles rectangular and subacute; sides broadly arcuate, slightly straighter posteriorly than anteriorly, margin acute but not noticeably beaded; basal angles obtuse and distinct; base slightly sinuate laterally; disk densely but not very coarsely, and more or less confluently, punctate; punctures rather discrete along the lateral margin.

Elytra oval, about a third longer than wide, somewhat inflated; disk with nine discal series of moderately strong punctures and a short scutellar row which is more or less confused and indistinct; the series becoming obsolete on the apical declivity before the apex; intervals with few extremely fine punctules. Body beneath strongly and coarsely punctate on the metasternum, punctures slightly finer on the prosternum, still

finer on the abdomen toward base, and distinctly fine on last three segments. Legs moderate in length, finely and rather evenly punctate.

Male: Usually a little smaller than the opposite sex; elytra less broadly oval, abdomen less convex.

Length (types) 8.5-9.5 mm.; width 4-4.5 mm.

Type: Female, No. 1682, and *allotype,* male, No. 1683, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 13, 1922, on **Middle San Benito Island.** *Paratypes,* same data and from East and West San Benito Islands, August 12, 13, 1922. 106 specimens studied.

In *S. puncticollis* the elytral series of coarse punctures are entire and attain the apex. In *williamsi* the series become obsolete on the apical declivity as in Triorophus. In *hannai* the form is narrower in both sexes and not in the least inflated, punctuation of head and pronotum coarser and more evidently coalescent; punctuation of abdomen stronger. *S. sparsa* is more polished, the pronotal punctures discrete and well separated and basal angles of pronotum very small and acute. *S. opaca* is very different in its dull surface and convex elytral intervals.

29. **Stibia hannai** Blaisdell, new species

Form elongate suboval, elytra not inflated and strongly convex. Color nigro-piceous; legs and antennæ rufo-piceous; luster shining, head and pronotum slightly duller, surface glabrous.

Head coarsely and confluently punctate; deflexed epistomal lobe obtusely triangular, line forming upper limit of deflexed portion continuous with sides of front, not strong, but more so than in *williamsi;* surface impressed behind the raised frontal line. Antennæ slender, extending to beyond the pronotal base.

Pronotum transverse, widest before the middle; apex truncate; apical angles acutely rectangular; sides broadly arcuate, straighter behind and converging to the base, margin acute; base slightly arcuate at middle and feebly sinuate laterally; basal angles obtuse and distinct; disk quite coarsely, densely, and more or less confluently punctate, slightly and narrowly impressed along lateral edge, where the surface is shining and glabrous with the punctures finer and discrete.

Elytra oval, about twice as long as wide, sides subparallel; base equal to pronotal base, humeri obtuse and distinct; sides broadly arcuate to apex, the latter rather narrowly rounded; disk with unimpressed striæ

of rather large and closely placed punctures which become more or less obsolete before attaining the apex; intervals obsoletely punctulate.

Abdomen rather coarsely and not closely punctate on first three segments, punctures finer on fourth and fifth segments. Sterna and side pieces coarsely and strongly punctate. Legs moderately and somewhat finely, densely punctured.

Male: Usually smaller and rather less elongate. Female: Larger and rather more elongate. Elytra similar in the two sexes.

Length (types) 7-8 mm.; width 2.5-3 mm.

Type: Female, No. 1684, and *allotype*, male, No. 1685, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 1, 1922, on **Angulo Rock, Asuncion Island.** *Paratypes*, same data and Natividad Island, August 3, 1922, in collection of the Academy and in that of the author. 46 specimens studied.

S. hannai differs distinctly from *williamsi* in its narrower and more elongate form, and coarser punctuation of head and pronotum; elytral striæ less abbreviated on apical declivity than in *williamsi*. Other differential considerations are given under the latter species.

30. **Centrioptera spiculifera** Lec.

This species occurs on Santa Margarita Island, where a single specimen was obtained by Hanna and Slevin July 29.

31. **Centrioptera pectoralis** Blais.

One specimen taken at Grand Cañon, Cedros Island, August 7, by Hanna and Slevin.

32. **Argoporis ebenina** Horn

San Benito Island. Four specimens were collected on August 13, by Hanna and Slevin.

33. **Argoporis impressa** Blaisdell, new species

Form elongate oblong-oval, subparallel and moderately convex. Color black; legs and antennæ concolorous, dark rufous or lighter, antennæ frequently somewhat darker; luster dull and feebly shining.

Head very finely and rather densely punctate, sides not broadly reflexed; surface depressed along frontal suture, front feebly convex; epistoma feebly and evenly convex, apex slightly arcuate, with a very small emargination at middle, on each side of which is a feeble tumescence. Antennæ short, moderately robust and slightly incrassate, joints seven to 10 transverse.

Pronotum subquadrate, a little wider than long; apex feebly arcuate, apical angles obtusely rounded; sides broadly arcuate, very gradually convergent to base, the latter transverse and rather broadly beaded laterally; disk very minutely and subobsoletely punctulate, moderately convex and more or less arcuately declivous antero-laterally.

Elytra oblong-oval, two and a half times longer than pronotum; base equal to pronotal base, humeri minutely prominent; sides broadly arcuate and parallel, arcuately convergent posteriorly to the rather broadly rounded apex; disk with feebly impressed striæ of rather coarse punctures, the latter somewhat strongly impressed; intervals flat or slightly convex, extremely minutely punctulate.

Legs rather slender, finely punctulate. Abdomen finely punctulate and more or less rugulose.

Male: Usually a little larger than female. Middle of first abdominal segment with a small tubercle, the latter slightly raised and rounded, surrounding surface not noticeably more punctate. Posterior femora with a moderately slender acute tooth, about three times as long as wide at middle, edges very finely denticulate, especially posteriorly. Female usually smaller than male. Edges of tibial groove of posterior femora, finely denticulate in distal half.

Length (types) 13-12 mm.; width 4.2-3.9 mm.

Type: Male, No. 1686, and *allotype,* female, No. 1687, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 3, 1922, on **Natividad Island.** *Paratypes,* same data and from Angulo Rock, Asuncion Island, August 1, and San Roque Island, August 2, 1922. About 38 specimens studied.

The males of the several species present differential characters as follows: *A. inconstans* has a truncate epistomal apex and rufous legs, the femoral teeth are long; in *æqualis* the femoral teeth are truncate at tip and the epistomal apex arcuate; *ebenina* has black legs (sometimes rufous), the epistomal apex truncate and the elytra more smoothly sculptured, *nitida* has three equidistant teeth on hind femur, while in *costipennis* the elytra are sulcate and the femoral teeth are large, acute, with finely denticulate edges; *alutacea* has the teeth bifid and the edges finely denticulate, while *bicolor* has two small, acute and exactly equal teeth which are widely separated.

34. **Cerenopus concolor** Lec.

A single specimen was found at Bernstein's Spring, on Cedros Island, August 4, by Dr. Hanna.

35. **Eleodes pygmæa** Blais.

San Quintin, Lower California, one example, July 19, Dr. Hanna, collector.

36. **Eleodes insularis** Linell

Two females of this species were found at Grand Cañon, Cedros Island, August 7, by Hanna and Slevin.

37. **Eleodes militaris** Horn

Four specimens, Grand Cañon, Cedros Island, August 7, by Hanna and Slevin.

38. **Eleodes adumbrata** Blaisdell, new species

Form elongate, subfusiform oval to ovate, moderately convex, scarcely inflated. Color deep black, luster dull, feebly shining.

Head moderate, slightly transverse before the post-ocular line; front slightly convex, finely and irregularly punctate, punctures may be sparse along median line; sides straight and convergent in front of eyes, epistomal apex transverse, scarcely sinuate, angles obtuse, frontal suture evident or obsolete. Eyes moderate in size, slightly more prominent than side of front at anterior canthi. Antennæ slender, last three joints about as wide as long, scarcely wider than the preceding joints which are longer than wide; fourth joint equal in length to fifth and sixth taken together.

Pronotum about a third wider than long, widest at middle; apex arcuato-truncate between the acute and moderately anteriorly prominent apical angles; sides quite evenly and broadly arcuate from apex to base, with a very feeble tendency to become sinuate near the angles, marginal bead fine; base broadly arcuate and about equal to apex; basal angles obtuse and not in the least prominent; disk rather strongly and evenly convex from side to side; rather strongly declivous at the apical angles where the surface of the angles is slightly impressed; extremely finely to subobsoletely punctate.

Elytra oval, obtusely pointed behind, about a third longer than wide; base broadly and feebly emarginate, adapted to and equal to the pronotal base; humeri obtuse, angle distinct but not in the least prominent; sides broadly arcuate becoming somewhat straighter and oblique in apical third to apex; disk moderately convex on dorsum, more strongly and rather broadly rounded laterally, finely punctate; punctures equal; strial series more or less distinct; interstitial punctures sparse and irregular; intervals more or less convex giving a feebly costate appearance; arcuately and rather gradually declivous posteriorly.

Abdomen finely and sparsely punctate, more or less rugulose; punctures denser on fifth segment, each with a brownish seta, the latter dense on and about the apical margin. Legs moderately long, relatively slender, closely and finely punctate, each puncture with a small brownish seta; posterior tibiæ slightly arcuate; anterior femora armed in both sexes; inner edge of the tibial groove slightly explanate with tooth at about apical fourth, thence sinuate to apex.

Male: Narrower and subfusiform-oval. Abdomen on same plane as sterna, moderately convex, flattened at middle of first three segments, more or less impressed in median line; anterior tarsal grooves open. Female broader and more ovate; abdomen more strongly and evenly convex.

Length (types) 24-22.0 mm.; width 8.5-9 mm.

Type: Female, No. 1688, and *allotype,* male, No. 1689, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 13, 1922, on **Middle San Benito Island.** *Paratypes,* same data and from East and West San Benito Islands, and on Asuncion Island, August 1, 1922, in collection of the California Academy of Sciences and in that of the author; 17 specimens studied.

E. adumbrata belongs to the *eschscholtzii* group of the subgenus *Eleodes* and should follow *inflata* in our lists. It differs from all others of the group by the fine, equal elytral punctuation; in the typical form, the elytra are subcostate.

39. **Eleodes discincta** Blaisdell, new species

This species is closely related to *adumbrata,* but differs mainly in the flat elytral intervals; strial punctures usually slightly larger than the interstitial, and never as coarse as in *lucæ* or *inflata.* Otherwise it is similar to *adumbrata.* It also belongs to the *eschscholtzii* group and should follow *adumbrata* in our lists. It also presents greater variation in size

and the males are markedly elongate, somewhat resembling the same sex in *longicollis* and *gigantea*.

Length (types) 25 mm.; width 9-10 mm. The largest and most elongate male from Asuncion Island, measures 32.5 mm. in length and 9 mm. in width; largest and most robust female from Santa Margarita Island, measures 33 mm. in length and 12 mm. in width.

Type: Female, No. 1690, and *allotype*, male, No. 1691, Mus. Calif. Acad. Sci., collected by Dr. G. D. Hanna, August 3, 1922, on **Natividad Island.** *Paratypes,* same data, and on Angulo Rock, Asuncion Island, Cedros Island and on Santa Margarita Island, July 29, 1922.

E. discincta occurs also on the mainland at San Quintin if two females in the author's collection are correctly labelled. I believe these specimens were taken on a former expedition sent out by the California Academy of Sciences to the Galapagos Islands in 1905-6, and were collected by Mr. F. X. Williams.

40. **Eleodes inepta** Blaisdell, new species

Form elongate, subfusiform oval, about three times as long as wide, moderately convex. Color deep black, very dull in luster and alutaceous.

Head rather small, short before the post-ocular line; front convex, finely, sparsely and irregularly punctate, each puncture with a small ferruginous hair; sides of the front feebly arcuate and convergent anteriorly, apex of the epistoma truncate and the angles obtuse and somewhat rounded. Eyes small. Antennæ slender, joints less elongate than in *armata* and less stout than in *militaris,* not in the least incrassate.

Pronotum quadrate, widest at middle; apex arcuate between the angles, which are acute and equilaterally triangular; sides evenly and broadly arcuate from apex to base, the latter broadly and feebly arcuate; basal angles obtuse and distinct; disk evenly and quite strongly convex, laterally noticeably declivous, very minutely and not closely punctulate.

Elytra elongate, base feebly emarginate, equal to and adapted to the pronotal base; humeri obtuse, distinct and not in the least prominent; sides broadly and evenly arcuate, obliquely convergent to apex in rather more than apical third, apex quite narrowly rounded; disk rather more than moderately convex on the dorsum, a little more strongly and broadly rounded laterally, punctures fine, equal in size, rather widely spaced in unimpressed and feeble striæ, the interstitial punctures forming a single more widely spaced series.

Abdomen moderately convex, slightly flattened along the middle third but not impressed on the first three segments in the type; apical margin

of the fifth ventral segment thickly set with short ferruginous setæ. Legs relatively long, moderately slender; all femora armed; hind tibiæ arcuate in basal two-thirds, thence straight and thickened to apex. Tarsi rather long; plantar grooves of the front tarsi widely open.

Length 23 mm.; width 7.6 mm.

Type: Male, No. 1692, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 1, 1922, on **Angulo Rock, Asuncion Island.**

E. inepta is described from a unique. It is sufficiently distinct from all other members of the *armata* group. From the standpoint of analogy, it is expected that *inepta* will vary as regards the size and sculpturing of individuals. It is to follow *armata* in our lists.

41. **Eleodes morbosa** Blaisdell, new species

Form suboblong-ovate to ovate, about twice as long as wide, resembling certain forms of *omissa* of the subgenus Melaneleodes. Color black, somewhat piceous, especially the appendages; luster moderately shining, head and pronotum somewhat alutaceous.

Head relatively moderate in size; front slightly convex, sparsely and finely punctate, frontal suture more or less evident, surface slightly impressed within the supra-antennal convexities where the punctures are somewhat denser. Eyes and posterior canthi a little more prominent than the sides of the front, which are convergent anteriorly, epistomal apex truncate, or very feebly sinuate. Antennæ comparatively slender and moderate in length, terminal three joints slightly incrassate and slightly transverse; joints four to eight inclusive a little longer than wide, the eighth being subtriangular.

Pronotum about a fifth or a fourth wider than long, widest slightly in front of the middle; apex slightly and broadly emarginate between the anterior angles, which are subacutely rectangular and slightly prominent anteriorly; sides broadly and rather strongly arcuate from apex to base, but less so behind the middle, marginal bead fine; base broadly and feebly arcuate; basal angles obtuse, not rounded and deflexed; disk moderately strongly convex, feebly and narrowly impressed along the sides within the bead, evenly declivous antero-laterally, punctures very fine and rather widely separated, evenly distributed.

Elytra oval, base truncate and equal to the pronotal base, humeri obtuse but distinct; sides evenly and broadly arcuate, somewhat oblique to apex in apical third, apex quite narrowly rounded; disk rather strongly convex,

slightly less so on the dorsum, rather arcuately declivous posteriorly; punctures moderately small, closely placed in unimpressed striæ, and more widely spaced interstitial series; punctures becoming more or less confused laterally and on the apex where they are finely but distinctly muricate.

Abdomen rather finely and not densely punctate. Legs moderate and relatively short, rather densely sculptured and sparsely clothed with ferruginous setæ. All of the femora armed; tooth of the anterior femora small and acute, of the middle and posterior femora small and obtuse; all of the tibiæ slightly arcuate, especially in basal third.

Males: Narrower. Abdomen less convex and impressed along the middle of the first three segments. Plantar grooves open on all the tarsi. Elytra somewhat more obliquely declivous posteriorly. Female: broader, abdomen more convex.

Length (types) 17-18.5 mm.; width 6.5-8 mm.

Type: Female, No. 1693, and *allotype,* male, No. 1694, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 1, 1922, on **Angulo Rock, Asuncion Island.** *Paratypes,* same data and on San Roque Island, August 2, 1922. 157 specimens studied.

E. morbosa is a very unique type in the fauna of the western coast, as it has more of the facies of a Melaneleodes than a member of the *armata* group of the subgenus Eleodes. All of the femora are armed. It agrees with certain species of the Mexican fauna in these respects, but its true relation to the *armata* group cannot be determined until some of the Mexican species have been carefully studied, especially as regards the genitalia; it may have to be placed in a different section of the *armata* group.

42. **Megasattus erosus** Horn

One imperfect specimen was taken on Cedros Island at Bernstein's Spring, August 4, by Hanna and Slevin.

43. **Cœlotaxis punctulata** Horn

A series of 24 specimens of this species was picked up at N. E. Landing, Guadalupe Island, July 11-15, by Hanna and Slevin.

44. **Conibius guadalupensis** Casey

N. E. Landing, Guadalupe Island, July 11-14; Pine Ridge, July 15, Hanna and Slevin. 13 specimens.

45. **Tonibius sulcatus** Lec.

San Quintin, Lower California, July 19, Dr. Hanna. 2 examples.

46. **Tonibiastes costipennis** Horn

A single specimen was secured on Santa Margarita Island, July 29.

47. **Cœlocnemis slevini** Blaisdell, new species

Form elongate, rather strongly convex. Color deep black, shining; surface glabrous.

Head moderately large, widest between the antennæ, thence convergent and straight anteriorly to the epistomal apex, the latter truncate, angles obtuse and slightly rounded; front impunctate, with few vague impressions, frontal and oblique sutures more or less evident. Eyes not in the least prominent, just noticeably convex. Antennæ short, attaining about the basal third of the pronotum, slightly and gradually clavate, distal five joints compressed, eleventh widest.

Pronotum about a fourth or less wider than long, widest near the middle; apex truncate in rather moderate circular arc; apical angles quite broadly rounded into the sides, which are rather strongly and evenly arcuate before the middle, thence convergent and more or less broadly and rather feebly sinuate to the base, marginal bead very fine; base truncate and more or less obsoletely margined; basal angles obtuse to rectangular and perfectly distinct; disk moderately strongly convex, impunctate and sculptureless; rather more strongly declivous antero-laterally, more so postero-laterally in about basal fourth, where it appears slightly compressed.

Elytra oblong-oval, usually widest behind the middle, strongly convex, moderately less so and slightly depressed on the dorsum; base truncate, not wider than the pronotal base; scutellum small and triangular; humeri very obtuse and rounded; sides broadly and quite evenly arcuate, rather less so anteriorly, apex oval; disk rather obliquely and arcuately declivous posteriorly, with eight rows of unimpressed and fine punctures, which are rather unevenly spaced in the series; a ninth or marginal row is present against the margin throughout the length; series rather less evident on the apical declivity; intervals impunctate in the specimens at hand.

Body beneath obsoletely sculptured; abdomen somewhat rugulose. Legs moderately long; middle and posterior femora rather slender; obsoletely sculptured.

Male: Narrower; sides of the pronotum more broadly and evenly arcuate, not subangulate at middle; abdomen less convex and more strongly oblique to the sterna. Female: broader and more evidently widest behind the elytral middle; pronotal sides subangulate, rather more suddenly and broadly sinuate posteriorly; abdomen subhorizontal.

Length (types) 22.5-27 mm.; width 8.5-11 mm.

Type: Female, No. 1695, and *allotype,* male, No. 1696, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 7, 1922, in **Grand Cañon, Cedros Island.** *Paratypes,* same data, in the collection of the Academy and in that of the author. Described from five specimens.

After much study and deliberation, by comparing the above small series with nearly a thousand specimens from all parts of the Pacific Coast, Nevada and Arizona, I came to the conclusion that *slevini* is a distinct species. It resembles *magna* more than any other; in the female, however, the pronotal sides are subangulate with the disk slightly depressed at that point. It is not closely related to *dilaticollis* or *obesa.*

48. **Cratidus rotundicollis** Horn

Five specimens of this rare species were taken on Cedros Island, August 7, and on Asuncion Island at Angulo Rock, August 1, by Hanna and Slevin.

49. **Amphidora tenebrosa** Horn

A single specimen was taken at San Quintin, Lower California, July 19, by Dr. Hanna.

50. **Helops guadalupensis** Casey

This fine species was secured on Guadalupe Island, July 15 and 17 at the South Anchorage, by Mr. Slevin.

51. **Helops benitensis** Blaisdell, new species

Form elongate oval, subparallel, about two and a half times longer than wide. Color black; legs and antennæ dark rufo-piceous; luster shining.

Head densely and deeply punctate, punctures moderately coarse and more or less confluent; sides convergent anteriorly, emarginate at the oblique suture; epistoma truncate at apex, surface impressed on the frontal suture and along the sides to the apical margin of the epistoma. Eyes not more prominent than the sides of the front. Antennæ slender, third joint about equal to combined length of fourth and fifth; joints 4 to 8 longer than wide, subequal in length; terminal four joints compressed and gradually incrassate.

Pronotum about as wide as long, widest at middle; apex slightly arcuate in moderate circular arc; sides broadly arcuate, rather more strongly so in middle third, marginal bead fine; angles obtuse; base subtruncate; disk not impressed, densely and evenly punctate, punctures moderately coarse and coalescing slightly.

Elytra oval, base slightly bi-marginate; scutellum very short and transverse, entering very slightly between the elytra; humeri obtuse and distinct; sides evenly and broadly arcuate, apex rather broadly rounded; disk striato-costate, intervals convex, especially on the apical declivity, strial punctures rather coarse, closely placed and rather deep, striæ not impressed; intervals very finely punctulate; no interstitial tubercles on sides or apex.

Propleura rather coarsely punctate, with more or less coalescence. Abdomen moderately convex, finely and rather sparsely punctate, each puncture with a fine recumbent hair. Legs slender and relatively short; anterior tarsi noticeably dilated and clothed beneath with pale hair densely placed; middle and posterior tarsi with similar hair but arranged along the margins and at apex of the joints.

Length 10 mm.; width 4 mm.

Type: No. 1697, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 13, 1922, on **Middle Benito Island.**

Very distinct from any species of Helops known to me. At first there was some doubt as to whether or not it was a Helops. It answers to the generic test. The front is not as widely dilated as in other species and not or scarcely more prominent than the improminent eyes, covering base of mandibles as usual; clypeus short, coriaceous. The striato-subcostate elytra is rather unique.

52. **Catorama pusillum** Lec.

Two specimens of this small species were taken on Santa Margarita Island, July 29, by Dr. Hanna.

53. **Megasominus thersites** Lec.

One imperfect specimen and the elytra of another were picked up on Cedros Island, on August 4, by Hanna and Slevin.

54. **Ipochus insularis** Blaisdell, new species

Form elongate oblong-oval to slightly oblong-ovate, strongly convex. Color black to nigro-piceous and more or less shining. Pubescence abundant. Surface clothed throughout with erect, soft, pale, moderately long hairs that are very sparsely scattered; and coarser, recumbent, somewhat fulvous hairs; these latter densely but unevenly distributed, forming a pattern, particularly on the front and vertex of the head and peripheral parts of the pronotal disk, and a rather broad parasutural stripe on the apical declivity of each elytron, besides irregular and anastomosing patches on the disk, leaving a central oblong glabrous area across the suture in basal half. Antennæ densely clothed with a very fine appressed pile. Abdomen with moderately long hairs; distal half of femora clothed with pale fulvo-cinereous hairs with intermixed small black spots, tibiæ more or less densely invested with similar hairs and with tuft of fulvous hair on outer surface in apical third.

Head moderately convex, with few scattered punctures and a fine median impressed line; fronto-epistomal line transverse and rather prominent. Antennæ about as long as body.

Prothorax subglabrous, cylindrically convex and nearly as long as wide, base and apex truncate, sides moderately arcuate; surface with very small, closely placed punctures, and larger and sparsely placed asperities, especially on the sides and across the apex.

Elytra about twice as long as wide, or slightly less, and oblong-subcylindrical in form, more or less abruptly declivous posteriorly; disk with sparsely placed asperities. Body finely sculptured beneath. Legs moderate; femora moderately and gradually clavate, the anterior less so.

Male: Elongate oblong-oval and subcylindrical, elytra scarcely wider than the prothorax. Female: Elongate oblong-ovate, usually slightly flattened on the elytral disk; elytra somewhat widest behind middle and slightly wider than prothorax.

Length (types) 10.5 mm.; width 3.5-4.5 mm.

Type: Male, No. 1698, and *allotype*, female, No. 1699, Mus. Calif. Acad. Sci., collected by Hanna and Slevin, August 13, 1922, on **Middle San Benito Island.** *Paratypes,* same data, in collection of the Academy and in that of the author. Eight specimens.

I. insularis is quite distinct from *fasciatus* and its races. The most salient characters are its large size and distinct elytral asperities. The distribution of the elytral pubescence is distinctly different in pattern from that seen in *fasciatus,* where it forms transverse fasciæ.

55. **Estola sordida** Lec.

Bernstein's Spring, Cedros Island, August 4, collected by Slevin and Hanna.

56. **Ortholeptura insignis** Fall

One example of this fine species was found on Guadalupe Island, July 15, by Hanna and Slevin.

Plenaschopsis Blaisdell, new genus

This new genus differs from Trigonoscuta chiefly in having the corbels of the metatibiæ obscurely defined externally by spines, surface of corbel convex in its anterior half and covered with short, thick and obtuse spines or scales; sinuate posteriorly, with the outer angle prolonged and obtuse; corbels closed off from the articular cavity by a row of spines which are not closely placed; articular cavity not scaly as in Trigonoscuta. Genotype, *Plenaschopsis pilosisquama* Blaisdell, new species.

The following characters are common to both genera: Ocular lobes absent, antennal scrobes lateral and directed inferiorly; third joint of all the tarsi wider than second and deeply lobed; anterior tibiæ dilated at tip; antennal scape long, passing the eyes.

General form and appearance that of Trigonoscuta. The tribe Trigonoscutini, as defined by Pierce, must be revised so as to include the present genus. A tabular statement of the differences between the two genera may be given as follows:

Metatibial corbels closed.
Corbels concave; external angle not produced; articular cavities strongly cavernous and scaly..................*Trigonoscuta* Motsch.
Corbels convex anteriorly, feebly defined laterally, sinuate, with the external angle produced; articular cavities not deeply cavernous and not scaly....................................*Plenaschopsis*, n.g.

57. Plenaschopsis pilosisquama Blaisdell, new species

Form oval, less elongate than *Trigonoscuta pilosa* Motsch., robust, slightly more narrowed anteriorly than posteriorly. Color black, legs nigro-piceous, tarsi slightly lighter; surface densely covered with cinereous and plumbeo-cinereous scales, scarcely variegated in the type and clothed with sparsely placed, nearly erect greyish hairs; scales of two kinds, one round or oval as in *T. pilosa*, the other oval and villous or covered with minute filaments so as to appear shaggy.

Head and rostrum as long as the pronotum. Rostrum suboblong, distinctly narrower than the head and separated from it by a fine transverse subangulate line; upper surface finely canaliculate, tip truncate; scrobes deep and arcuate, with the superior margin distinct to and passing near the lower margin of the eyes, the latter oval, slightly oblique. Antennæ moderately long; scape almost gradually clavate, passing beyond the eyes posteriorly; funicle seven-jointed, first three obconic, first and second elongate, first nearly three times as long as wide, second slightly more than twice as long as wide; third a little longer than wide; four to six as long as wide and subglobular; seventh larger and about as long as the sixth and twice as wide as long; club oval. Front finely canaliculate between the eyes.

Pronotum a little broader than long, narrower in front; sides strongly arcuate, subapical impression very feeble; apex arcuate, slightly sinuate at middle; disk strongly arcuate from side to side, and suddenly and very briefly declivous before the base in middle two fourths, rather coarsely and closely punctate.

Elytra broadly oval, rather less than a third longer than wide; scutellum small and triangular; humeri broadly rounded; sides broadly and rather moderately strongly arcuate; disk strongly convex, rather abruptly and arcuately declivous posteriorly, with rows of rather fine punctures, which are very slightly impressed.

Body beneath not densely scaly; third and fourth abdominal segments equal in length; hairs sparse and rather long; scales of the under surface nearly all shaggy as they are on sides of pronotal disk, and on sides, base and apex of the elytra, with a few similar ones above the eyes; elsewhere the scales are round or slightly oval. Legs not closely scaly, hairs quite long and flying.

Length 6.6 mm.; width 4 mm.

Type: Female, No. 1817, Mus. Calif. Acad. Sci., collected by Dr. Hanna, August 3, 1922, on **Natividad Island.**

In *pilosisquama* the peculiar shaggy scales, less widely open antennal scobes just before the eyes, antennal joints four to six subglobular, and the different corbels of the hind tibiæ will amply distinguish this species from *Trigonoscuta pilosa,* which it resembles in most all other characters. Described from the unique type.

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XV

ANTHIDIINE BEES IN THE COLLECTION OF THE CALIFORNIA ACADEMY OF SCIENCES

BY

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1. **Anthidium angelarum** Titus

Females: Colton, May 26-28 (Van Duzee); hills back of Oakland, May 8 (Van Dyke); Santa Monica (F. C. Clark); Stone Cañon, Monterey Co., April 21 (Van Duzee); Poway, San Diego Co., June 10 (Blaisdell); all in California.

Males: Cisco, July (Mrs. H. E. Ricksecker); Meadow Valley, 3500-4000 ft., June 5 (Van Dyke); Poway, San Diego Co., May 31 (Blaisdell); South Sonoma Co., July 1 (Kusche); all in California.

2. **Anthidium nebrascense** Swenk

Swenk described this (1914) from Nebraska and Wyoming. The following year he recorded it from Truckee, Calif. The Californian specimens before me show variation, but they agree so closely with the description of *A. nebrascense* that I do not know how to separate them. They are close to *A. titusi* Ckll., but the end of the abdomen is different.

Males: Panoche Cañon, Fresno Co., April 29 (Van Dyke); Colton, May 26-28 (Van Duzee); Poway, San Diego Co., May 16 (Blaisdell); hills back of Oakland, May 15 (Van

Dyke); Santa Monica (F. C. Clark); Stone Cañon, Monterey Co., April 21 (Van Duzee); all in California.

The only female which seems likely to belong to these males is the one which I have identified as *A. emarginatum atripes* Cresson, but the type (male) of *atripes* is certainly not *nebrascense*. I must leave the final decision about the supposed *atripes* to those who can study the species in the field. The black scutellum of the *nebrascense* males certainly argues against their association with the supposed *atripes;* but Swenk has what he regards as female *nebrascense* from Wyoming, and it had two linear marks on scutellum.

3. **Anthidium hesperium** Swenk

Females: Mokelumne Hill, October (Blaisdell); San Diego (Blaisdell); Millbrae, San Mateo Co., Sept. 1 (Blaisdell); Crystal Lakes, San Mateo Co., June 25 (Van Duzee); all in California. The first abdominal segment usually has an interrupted band instead of four spots, but the insect agrees otherwise with Swenk's description, based on females from Palo Alto and Pacific Grove. The male is unknown. The species seems to belong to late summer and early fall, the earliest date being June 25, the other known dates in July, September and October.

4. **Anthidium atriventre** Cresson

Females: Meadow Valley, Plumas Co., Calif., 6000-7000 ft., June 17 (Van Dyke); Sparta, Baker Co., Oregon, July 2 (Van Dyke). Cresson described it from California (Hy. Edwards).

5. **Anthidium titusi** Cockerell

Males: Kings River Cañon, Fresno Co., Calif., July 3 (Van Dyke); Huntington Lake, Fresno Co., Calif., 7000 ft., July 4 (Van Duzee). These specimens have the scutellum entirely black. The Kings River Cañon specimen has hair of head and thorax above pale fulvous. The reference of these California insects to *A. titusi* must be considered provisional, or at least

they may be racially distinct. However, the form and structure agree well.

6. **Anthidium blanditum** Cresson

Female: South Fork Kings River, Fresno Co., Calif., July 8 (Van Dyke). This is smaller than Cresson's type, and has two elongate black marks on clypeus, no spot beneath tubercles, abdominal bands on segments 2 to 4 narrowly interrupted, and the femora rather differently marked. I assume that it represents only a variation, but more material is desirable. It is readily known from *angelicum* by the angulation at sides of last segment. The abdominal bands are broad and deep yellow.

7. **Anthidium fresnoense** Cockerell, new species

Female: Length about 8.5 mm.; robust, black, head and thorax with white hair, pure white on thorax above; eyes bluish green, black at lower end; head entirely black, including mandibles, except a round yellow spot above each eye; mesothorax very densely punctured; large mark on tegulæ in front, very small one behind, end of the obtuse tubercles, and elongate marks on axillæ and scutellum, yellow; scutellum depressed in middle posteriorly; legs black, the tibiæ with yellow stripes, not reaching the apex; hair on inner side of hind basitarsi black; wings dusky, second cubital cell long; abdomen with five lemon-yellow bands, and on first segment four marks, the outer ones large and quadrate, the inner consisting of transverse stripes; bands on segments 2 to 6 all narrowly interrupted and emarginate at sides anteriorly; ventral scopa dark gray-brown, white anteriorly and at sides.

Differs from *A. palliventre* Cress. by the scutellum, axillæ and tibiæ being conspicuously marked with yellow. The lemon-yellow abdominal bands at once separate it from *A. tenuifloræ* Ckll.

Type: Female, No. 1729, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 12, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft. elevation.

8. **Anthidium xanthognathum** Cockerell, new species

Female: Length 7-8 mm.; compact, black with rather pale, dull yellow markings; hair of head and thorax dull white, varying to fulvous above;

eyes pea-green, black at lower end; face all black but mandibles yellow, more or less stained with red; a pale yellow spot above each eye, mesothorax shining between punctures; tegulæ broadly in front, end of the obtuse tubercules and two transverse marks on scutellum, pale yellow; the axillæ may also be marked with yellow; wings somewhat dusky; small joints of tarsi ferruginous; all the tibiæ with a yellow mark at base, or front pair with a stripe nearly to apex; hair on inner side of hind basitarsi pale ferruginous; abdomen with four marks on first segment, the lateral ones large and quadrate; segments two to six with narrowly interrupted bands, on 2 and 3 broadly emarginate at sides in front; on sixth segment the band is reduced to a pair of large transverse subpyriform spots; ventral scopa entirely white.

Type: Female, No. 1730, Mus. Calif. Acad. Sci., collected by Dr. F. E. Blaisdell, September 6, 1896, at **Mokelumne Hill, California.** Variant form from Soboba Springs, California, June 5, 1917 (Van Duzee). The alternative statements in the description refer to the latter. Resembles *fresnoense,* but smaller, with yellow mandibles.

9. **Anthidium fontis** Cockerell, new species

Male (type): Length about 9 mm.; black with yellow markings, pale on face, but deep lemon-yellow on abdomen; head and thorax with abundant long hair, fulvous dorsally, otherwise whitish; eyes entirely pea-green; antennæ black, flagellum very obscurely brown beneath; mandibles, except apex, clypeus, lateral face marks (truncate above at about level of antennæ) and dots above eyes, all yellow; mesothorax very densely punctured; tegulæ broadly in front and spot behind, tubercles, two lines on scutellum, stripes from end to end of anterior and middle tibiæ, and apical and basal spots on hind tibiæ, all yellow; basitarsi pale yellow, small joints red; wings dusky; first abdominal segment with large lateral and pyriform median spots; segments 2 to 6 with narrowly interrupted bands, more or less emarginate anteriorly at sides; seventh segment entirely dark red, with very broad short lobes, much broader than distance between either and the median spine; last ventral segment with a deep median sulcus.

Female: Length about 8-8.5 mm., with bright lemon-yellow markings; eyes bluish green, black below; greater part of mandibles, clypeus except two coalescent black triangles above, lateral face marks, broadly truncate below level of antennæ, and large triangular spots above eyes, all yellow; the yellow on thorax and legs includes bent stripe along each side of mesothorax, broad marks on axillæ and scutellum, marks on tegulæ anteriorly and posteriorly, tubercles, stripes on apical part of anterior and middle femora beneath, spot on hind femora, broad bands on outer side

of all tibiæ and large marks on hind basitarsi; first abdominal segment with four spots, the inner one transverse but not linear; segments 2 to 6 with broad bands, the first two slightly interrupted, the others notched, the first deeply, the second shallowly emarginate at sides, the last with a double emargination (two notches) at each side in front; ventral scopa entirely pale.

Type: Male, No. 1731, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, between May 31 and June 3, 1917, at **Soboba Springs, Riverside Co., California.** *Paratypes:* Four males and one female, same data; one female Bryson, Monterey Co., Calif., May 18, 1920 (Van Duzee). Allied to *A. angelarum* Titus, but certainly distinct, especially by the terminal segment of the male abdomen.

10. **Anthidium permaculatum** Cockerell, new species

Female: Length 10-10.5 mm.; robust, black, with very pale yellow markings; hair of head and thorax dorsally fulvous, otherwise white; clypeus broadly black in middle, with an elongate pale mark on each side; lower edge of clypeus bidentate at each side; lateral face marks large, obliquely truncate above; mandibles with a large yellow mark; a cuneiform yellow mark above each eye; yellow of thorax and legs consisting of large spot on front and small behind on tegulæ, stripes along edge of mesothorax above, tubercles, marks on axillæ and scutellum, stripes on under side of anterior and middle and spot on hind femora, outer face of tibiæ, and mark on hind basitarsi; small joints of tarsi ferruginous; hair on inner side of hind basitarsi reddish brown; wings dusky; first abdominal segment with four marks, the inner ones larger and subtriangular; segments 2 to 6 with broad bands, on 2 interrupted in middle and deeply notched at sides, the median parts broad claviform, on 3 narrowly interrupted in middle and deeply notched at sides in front, on 4 and 5 deeply notched in middle and shallowly emarginate at sides; sixth segment strongly angulate at sides posteriorly, nearly all pale, the light color doubly emarginate at each side in front; ventral scopa pure white.

Type: Female, No. 1732, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, July 2, 1922, at **Sparta, Baker Co., Oregon.** *Paratype:* Baker, Oregon, June 3, 1922 (Van Dyke). Known from *A. hesperium* Swenk by the very pale abdominal bands and the sixth segment strongly dentiform at sides. The last character and the face marks separate it from *A. emarginatum* Say, which it superficially resembles.

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11. **Anthidium divisum** Cockerell, new species

Female: Length about 7.5 mm.; compact, black, with cream-colored markings; hair of head and thorax reddish above, otherwise white; eyes sea-green, black at lower end; base of mandibles, large patch at each side of clypeus, not reaching upper end, lateral face marks adjacent to sides of clypeus and not quite reaching orbits, and spot above eyes, yellowish white; mesothorax very densely punctured; anterior and posterior spots on tegulæ, hardly visible stripe above, well developed marks on axillæ and scutellum, tubercles, and stripes on all the tibiæ, not reaching apex, cream-color; hair on inner side of basitarsi light ferruginous; wings somewhat dusky; abdomen with four spots on first segment, the outline of the discal ones straight behind and strongly convex in front; segment 2 to 6 with narrowly interrupted bands, that on 5 not quite interrupted, band on 2 deeply notched anteriorly at sides; ventral scopa pure white.

Type: Female, No. 1733, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 24, 1922, in **Parley Cañon, Salt Lake City, Utah.** *Paratype:* Cayton, Shasta Co., California, July 13, 1918 (Van Duzee). Variety with clypeal markings reduced to a small round spot on each side, lateral marks to small nearly divided marks next to clypeal margin and stripe on anterior tibiæ divided into two, from Pine View, Utah, July 21, 1922 (Van Duzee). Allied to *permaculatum* but considerably smaller and the lateral face marks not larger than the clypeal marks.

12. **Anthidium divisum ornatifrons** Cockerell, new variety

Female: Clypeal patches larger, approaching in middle line, and between them, with its base touching them, a small yellowish triangular mark, its apex directed upward.

Type: Female, No. 1734, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, June 15, 1924, at **Meadow Valley, Plumas Co., California,** at 3500-4000 ft. The face marks rather suggest *A. sagittipictum* Swenk.

13. **Anthidium divisum nanulum** Cockerell, new variety

Female: Very small, length about 5.3 mm.; markings distinctly yellower than in the other two forms; clypeus very pale yellowish, with a pair of black triangles, contiguous at base, their apices pointing downward, on upper part, and also a very small black spot next to the lower

margin in middle; lateral marks filling space between clypeus and eye, and broadly truncate a short distance above level of top of clypeus; spots above eyes pyriform.

Type: Female, No. 1735, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 20, 1920, at **Bryson, Monterey Co., California.** Perhaps a distinct species.

The following key will facilitate the separation of the females described above:

Face entirely black 1
Face not all black.. 2
1. Larger; mandibles black............................*fresnoense* Ckll.
Smaller; mandibles yellow........................*xanthognathum* Ckll.
2. Middle of clypeus black from base to apex......................... 3
Middle of clypeus not black to apex................................ 5
3. Abdominal bands deep yellow.....................*hesperium* Swenk
Abdominal bands pale.. 4
4. Larger; lateral face marks much larger than clypeal marks........
....*permaculatum* Ckll.
Smaller; lateral marks not larger than clypeal marks..*divisum* Ckll.
5. Abdominal bands and clypeal marks cream-color................... 6
Abdominal bands yellow or orange..................................... 7
6. Larger; area between clypeus and eye not all light...............
....*divisum ornatifrons* Ckll.
Smaller; area between clypeus and eye all light...................
....*divisum nanulum* Ckll.
7. Upper edge of clypeal yellow W-like.................*fontis* Ckll.
Not so; clypeus with spots or stripes................................ 8
8. Larger; (for other characters see description)...................
....*pecosense fragariellum* Ckll.
Smaller 9
9. Last segment yellow, strongly angulate at sides....*blanditum* Cress
Last segment not angulate at sides...............*angelarum* Titus

14. **Anthidium mormonum** Cresson, and allies

In 1878 Cresson described this species from a single male obtained by Ulke in Utah. In 1879 he described *A. blanditum,* based on a couple of females collected by Morrison in Nevada. In 1904 I described *A. pecosense* and *A. bernardinum,* the latter with three varieties. In 1911 I remarked, "The female of *A. pecosense* so nearly agrees with the description of *A. blanditum* from Nevada as to suggest that the two represent varia-

tions or races of one species." Swenk in 1914 made the combination *A. blanditum pecosense* (Ckll.). Certainly we have here a group of very closely allied forms, difficult to classify correctly. The relatively large *A. bernardinum*, with rich orange markings, the apical lobes of the male abdomen very broad, the axillæ orange, and other good characters, may be set aside as distinct. *A. aridum* (*A. bernardinum aridum* Ckll.) is certainly distinct from the others by the pointed apical lobes of the abdomen, scape yellow in front, entirely black axillæ, etc.

Three males from Beaver Creek, Kamas, Utah, July 4, 1922 (Van Duzee), must be referred to *A. pecosense*, though the apical lobes of abdomen are variable, in one specimen spreading instead of parallel. The hair of thorax above is fulvous; the axillæ have small yellow spots; the yellow of anterior tibiæ is continuous. These differ from *A. mormonum* by the fulvous dorsal pubescence, the large discal spots on first abdominal segment and the more spreading apical lobes of abdomen, with broader and shallower sinus between lobes and median spine. It is thus unsafe to assert that *mormonum* and *pecosense* are one species, though it may be that they will prove inseparable, or only racially distinct.

The males described from California as varieties *fragariellum* and *wilsoni* of *A. bernardinum* belong rather to the *mormonum-pecosense-blanditum* alliance, as shown by the apical lobes of abdomen and the merely spotted axillæ. They evidently represent a single species, but the dorsal hair of thorax is white in *fragariellum*, yellow-fulvous in *wilsoni*. The *wilsoni* form is represented by three males from Meadow Valley, Plumas County, California, 4000 ft., June 8 and 15 (Van Dyke), except that these have the yellow on anterior tibiæ interrupted, whereas in typical *wilsoni* it is continuous. The *fragariellum* form is represented by males from Meadow Valley, 3500-4000 ft., June 21 (Van Dyke); South Fork Kings River, Calif., July 8 (Van Dyke), and Fallen Leaf Lake, Calif., July (L. S. Rosenbaum). The last has the yellow on anterior tibiæ interrupted, but it is entire on the other two, and also in typical *fragariellum*.

These California males run smaller than *A. pecosense* and have more yellow on apical segment of abdomen. In the type

of *fragariellum*, but not in the others, the yellow on first segment of abdomen consists of a pair of large cuneiform patches, deeply incised posteriorly. This also has large yellow patches on anterior and middle femora, but the series shows that these vary. I conclude that the Californian insect is a valid subspecies of *A. pecosense*. The name *fragariellum* is to be preferred over *wilsoni*, having priority where it is first printed, in the table published May, 1904.

Coming now to the females, we fortunately have a couple from Meadow Valley, 3500 to 4000 ft., June 8 and 21 (Van Dyke), certainly belonging with the males just recorded. The one of earlier date has hair of head and thorax above deep fulvous; in the other it is much paler but not white. In both the clypeus is entirely yellow. This insect agrees with the description of *A. blanditum* except for the fact that there is a large oblong yellow patch on mesopleura, and perhaps also in the more fulvous dorsal pubescence. The patch on pleura seems to be of little importance because a female of the same species from Fallen Leaf Lake, California, June 26 (Van Dyke), has the mesopleura entirely black. The same is true of one from Guerneville, Sonoma Co., Calif., May 30 (Van Dyke). These with black pleura have the hair of head and thorax above strongly fulvous. The female of *A. pecosense*, as identified by me from Flagstaff, Arizona, differs from the above Californian females in being larger, in having the mesopleura black, and yellow only bordering the tubercles; the dorsal hair is red. A female from Strawberry Valley, California (Davidson), which I ascribed to *A. bernardinum*, is small and agrees in all essential particulars with the one from Fallen Leaf Lake. It is better referred to *A. fragariellum*. Thus the whole series discussed will stand for the present thus:

A. bernardinum Ckll.
A. aridum (Ckll.)
A. mormonum Cresson
A. blanditum Cresson (?? of *mormonum*.)
A. pecosense Ckll. (? var. of *mormonum*+*blanditum*.)
A. pecosense fragariellum (Ckll.) (?=*blanditum*.)
A. pecosense fragariellum var. *wilsoni* (Ckll.) (apparently not a valid race).

The question marks can only be removed by further investigation.

15. **Anthidium tricuspidum** Provancher

California: Mokelumne Hill, June (Blaisdell); Crystal Lakes, San Mateo County, June 25 (Van Duzee); Cazadero, September 2 (Van Duzee). San Diego, Calif. (Blaisdell), male. Oregon: Crater Lake, 7000 ft., July 16 (Van Dyke).

16. **Anthidium bernardinum** Cockerell

California: Mill Creek Cañon, San Bernardino Co., September 21 (Van Duzee). The males are variable; hair on thorax above white or fulvous; scape practically all black or with a large yellow mark.

17. **Anthidium emarginatum atripes** Cresson

The following females differ from typical *A. emarginatum* in having the tibiæ entirely black. I can refer them only to Cresson's *atripes,* based on a male from Nevada.

California: Huntington Lake, Fresno Co., 7000 ft., July 4 and 27 (Van Duzee); Meadow Valley, Plumas Co., 3500 ft., June 21 (Van Dyke); Blue Lakes, Alpine Co., July and August (Blaisdell).

These females are distinguished among those with creamy-white markings by the white ventral scopa, face entirely black and scutellum and axillæ having prominent light markings. It is, however, a source of perplexity that I do not find a corresponding series of males. The possible males have the scutellum and axillæ entirely black, or at least with very small light spots, and certainly do not represent any form of *A. emarginatum.* These females appear to agree with *A. emarginatum* except for the black tibiæ. Only field observations will determine the actual facts.

18. **Anthidium maculosum** Cresson

Females from Yosemite Valley, Calif., June 21 (Van Dyke); Sisson, Calif., July 24 (Van Duzee), and Mokelumne Hill, Calif. (Blaisdell). Males from Anacapa Island, May 15 (Van Duzee), Huntington Lake, 7000 ft., July 27 (Van Duzee), Mill Creek Cañon, San Bernardino Co., Sept. 21 (Van Duzee), all in California, and Hereford, Arizona, July 12 (J. R. Slevin). Cresson in 1878 described *A. maculosum* from females collected in Utah and California; in 1916 he designated Utah as the type locality. In 1904 I described *A. lupinellum* from the male collected in New Mexico, and in 1923 recorded this species from the Gulf of California region. The six California and Arizona males before me are considerably larger than the type of *lupinellum,* but otherwise identical. I have now no doubt that *lupinellum* is the male of *maculosum,* and the species is to be known by the latter name.

19. **Anthidium palliventre** Cresson

This was based on a female collected in California by Hy. Edwards, characterized by the entirely black face, scutellum and axillæ, hair of the head and thorax above yellowish, ventral scopa entirely pale. The same collector obtained *A. californicum,* described from males. After a good deal of perplexity I am now compelled to conclude that they are sexes of one species, which takes the prior name *A. palliventre.* However, the color of the scopa varies from white to nearly all black, only the sides remaining white. I am convinced that this is not a specific character. Such variation has been recorded before, as in *A. astragali* Swenk. The females assigned to *palliventre* come from San Francisco, Calif., April (Van Dyke) and May (Kusche); Colma, Calif., August 15 (Kusche), and San Miguel Island, Calif., May 20 (Van Duzee). The last mentioned is unusually large with corners of sixth abdominal segment prominent. These all differ from the female of *A. tenuifloræ* Ckll. in having abdominal bands more or less interrupted in middle and the divisions claviform mesad. The male (*A. californicum* Cress.) comes from Colma, Calif.,

Aug. 15 (J. A. Kusche), and San Francisco, May 10, 21 and 30 (Kusche), and April 20 (Van Dyke). The dorsal hair of head and thorax is ferruginous, whereas in males from Los Angeles (Davidson) it is white, as I recorded in 1904.

20. **Anthidium plumarium** Cockerell, new species

Male: Aspect of *A. californicum,* including the red dorsal pubescence. At first I thought it a mere variety or race, but it is surely a distinct species by the following characters: Lateral apical lobes of abdomen stout but pointed (broadly rounded in *californicum);* mandibles broader; mouth parts ferruginous; upper edge of clypeus black with two pointed extensions downward; sixth abdominal segment with only two small yellow spots.

Evidently derived from *A. californicum (pallivcntre).*

Type: Male, No. 1736, Mus. Calif. Acad. Sci., collected by Dr. E. C. Van Dyke, June 5, 1924, at **Meadow Valley, Plumas Co., California.**

21. **Anthidium tenuifloræ** Cockerell

This Rocky Mountain species proves to extend into the Pacific coast region. The females are very like those of *A. pallivcntre,* but may be separated by the abdominal bands being very narrowly interrupted, the divisions not claviform but strap-shaped. The eyes are also darker. The ventral scopa is usually mainly or almost wholly black, but it varies to all light in Huntington Lake specimens. Females are from Huntington Lake, Calif., 7000 ft., July 4 (Van Duzee); Steen Mountains, Oregon, June 25 (Van Dyke), and Longmire, Rainier National Park, Wash., July 27 (Van Dyke). The last mentioned has the bands unusually slender. Males are from Longmire (same date as females) and Crater Lake, Oregon, 7000 ft., July 17 (Van Dyke).

22. **Anthidium banningense** Cockerell

The following references are to males; the basitarsi are cream colored in front and the anterior and middle tibiæ have a spot.

California: Meadow Valley, Plumas Co., 3500-4000 ft., June 21 (Van Dyke); Huntington Lake, Fresno Co., July 4 (Van Duzee); Blue Lakes, Alpine Co., August (Blaisdell). Utah: Logan, July 14 (Van Duzee); lateral apical spines of abdomen broader; sixth and seventh segments entirely black. Apparently not a race, as one of the Meadow Valley specimens is the same.

Readily known from male *A. emarginatum* by the long narnow lateral apical lobes of abdomen and the tegument of scutellum wholly black.

23. **Anthidium angulatum** Cockerell, new species

Male: Similar to *E. emarginatum* Say, but rather less robust; abdominal bands conspicuously paler (creamy white), and reduced to fine lines at the broad emarginations; hair of thorax above white; scutellum entirely black or with a pair of minute pale marks. Apical lobes of abdomen angulate as in *A. emarginatum*. Differs from *A. emarginatum atripes* Cresson by the broad band on fifth abdominal segment and pair of large comma-like marks on sixth, small pale marks on bases of tibiæ, and creamy white basitarsi. The clypeus may have or lack two small black spots. Perhaps to be regarded as a Californian race of *A. emarginatum*.

Type: Male, No. 1737, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 7, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft. *Paratype*, one male, taken by Dr. E. C. Van Dyke, July 11, 1915, at Fallen Leaf Lake, California.

24. **Anthidium brachyurum** Cockerell, new species

Male: Length about 10 mm.; black, the head and thorax with white hair, very fainty tinged with yellowish dorsally; flagellum obscurely reddish beneath except basally; light markings cream-color, the light parts being entire clypeus, lateral marks, truncate at about level of antennæ, mandibles except apically (red just before the black apex), small spots above eyes, tegulæ in front and small mark behind, small marks at bases of tibiæ, elongate mark near end of front tibiæ, subquadrate mark at apex of mid tibiæ, the basitarsi, large lateral and small dorsal marks on first abdominal segment, second segment similar but with larger dorsal marks, segments 3 to 5 with narrowly interrupted bands, deeply emarginate laterally, sixth with very large hook-like marks; seventh segment

entirely black with, very broad low lateral lobes narrowly separated from the central spine; tubercles, mesothorax, axillæ and scutellum entirely black; eyes pea-green; mesothorax extremely densely punctured; wings dusky; hair on inner side of hind tibiæ white.

With the type I associate two other specimens differing in some respects:

Salt Lake City, Utah, June 27, 1922 (Van Duzee); hair of head and thorax above abundant, light fulvous; apical lobes separated from spine by a deeper, rounded, emargination, but hardly half breadth of lobe; sixth segment with two large pyriform marks.

Redding, California, July 7, 1918 (Van Duzee); subapical marks on anterior tibiæ very minute; marks on sixth segment smaller; emargination between lobes and spine rather shallow and not abrupt. I think these are all one species, however. It is known from the related species by the broad low apical lobes of abdomen. Its nearest relative appears to be *A. montivagum* Cresson.

Type: Male, No. 1738, Mus. Calif. Acad. Sci., collected by Mrs. H. E. Ricksecker, in July, 1920, at **Cisco, California.**

25. **Anthidium hamatum** Cockerell, new species

Male: Length about or nearly 13 mm.; black, the head and thorax with abundant white hair, grayish dorsally; light markings cream-color, consisting of entire clypeus, lateral marks (filling space between clypeus and eyes and obliquely truncate above, the inner corner meeting upper corner of clypeus), mandibles except apex, spot at end of scape, small spot above eyes, tegulæ anteriorly and small spot behind, tubercles (which are obtuse), two very small lines on hind border of scutellum, marks at bases of tibiæ, spot at apex of middle tibiæ, basitarsi, large lateral and narrow transverse dorsal marks on first abdominal segment, bands on segments 2 to 5 (narrowly interrupted in middle and very widely emarginate at sides) and a pair of hook-like marks on sixth segment; apical segment and mesothorax entirely black; eyes gray; mesothorax extremely densely punctured; wings dusky; apical lobes of abdomen wide apart, obtuse, the outer side strongly concave, distance between lobes and spine much greater than width of lobes. The lobes resemble in form those of *A. mormonum* Cress. but are much wider apart.

Type: Male, No. 1739, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 8, 1922, on **Mt. Timpanogos, Utah.**

26. **Anthidium spinosum** Cockerell, new species

Male: Length about or slightly over 11 mm.; black, the head and thorax with abundant white hair, inclined to grayish dorsally; light markings cream-color, consisting of clypeus (except a pair of black lines on upper part), lateral marks (filling space between clypeus and eye, with upper end rounded), greater part of mandibles, spots above eyes, mark on tegulæ in front, two very small spots on scutellum (or none), basitarsi (but tibiæ all black), four spots on first abdominal segment (the lower smaller but not linear), bands on segments 2 to 5 (very narrowly or not quite interrupted in middle, very broadly emarginate at sides, the inner portion thick), and a pair of comma-like marks on sixth segment; eyes greenish gray; scutellum shining on disc; wings dusky; hair on inner side of hind basitarsi dark brown; tubercles entirely black, produced and spiniform; apical lobes of abdomen of the same type as those of *A. hamatum*.

Type: Male, No. 1740, Mus. Calif. Acad. Sci., collected by Dr. E. C. Van Dyke, July 11, 1915, at **Fallen Leaf Lake, California.** *Paratype,* one male, same data. I had taken this for a form of *A. hamatum* until I noticed the entirely different spiniform tubercles.

The new species described above and a related form may be separated as follows, all being males with the abdominal bands whitish or very pale:

Apical lobes finger-like; clypeus with two black spots............ ....*banningense* Ckll.
Apical lobes angular..............................*angulatum* Ckll.
Apical lobes broad and rounded.................................. 1
1. Apical lobes twice as broad as space between them and median spine . ...*brachyurum* Ckll.
Apical lobes not thus broadened................................. 2
2. Tubercles creamy white, obtuse seen from above.....*hamatum* Ckll.
Tubercles black, sharply pointed seen from above....*spinosum* Ckll.

27. **Anthidium flavicaudum** Cockerell, new species

Male: Length about or nearly 11 mm.; black with yellow markings (reddened by cyanide in type); head and thorax with white hair; eyes brown; flagellum obscurely reddish beneath; mesothorax extremely densely punctured; tubercles not spiniform; wings dusky; apical lobes of abdomen rounded, wide apart, apically much narrower than the distance between them and spine; spines at sides of sixth segment short and pale; yellow markings as follows: entire clypeus, lateral marks (ending above on orbit at level of antennæ, but the inner corner at top of clypeus, the oblique upper side curved); mandibles (except apex nar-

rowly), subpyriform spots above eyes, spot on front of tegulæ, tubercles, elongate marks on scutellum, shorter ones on axillæ, stripes on anterior and middle femora beneath, elongate mark on hind femora apically, entire outer face of tibiæ, basitarsi (small joints of tarsi clear ferruginous), broad bands on abdominal segments 1 to 6, on 1 broadly interrupted in middle and deeply emarginate or excavated posteriorly at sides, on 2 and 3 rather narrowly interrupted in middle and deeply but not widely excavated anteriorly at sides, on 4 very narrowly interrupted in middle and much more shallowly excavated anteriorly at sides, on 5 deeply notched in middle and merely undulate at sides, sixth yellow except black hind margin, seventh yellow with spine and broad apices of lobes black; venter with much white hair.

Differs from *A. pecosense wilsoni* (Ckll.) by the entirely black mesothorax and much shorter spines at sides of sixth segment (in *wilsoni* they are long and dark); they are however, closely allied. In *wilsoni* the tegulæ have the whole outer margin yellow.

Type: Male, No. 1741, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 26, 1918, at **Sisson, California.**

28. **Anthidium puncticaudum** Cockerell, new species

Male: Length about 11 mm.; black with lemon-yellow markings; hair of head and thorax white; eyes pea-green; mesothorax dull and granular; scutellum dull, with a little shining area on disc posteriorly; wings dusky; tubercles black, sharply pointed but not spiniform; spines at sides of sixth abdominal segment long and black; lobes of terminal segment broad and rounded, produced, the ends separated by more than their width from the spines; lemon-yellow markings as follows, entire clypeus, lateral marks (filling space between clypeus and eye and obliquely truncate above), mandibles except tips, spot above eyes, mark on tegulæ in front and small one behind, stripes on all the tibiæ (on middle ones interrupted), basitarsi (small joints ferruginous), four spots on first and also on second abdominal segments, the dorsal spots on first small, but on second large and similar to the corresponding parts on third, where, as also on fourth, they are connected by a slender line with the lateral spots, fifth segment with a narrowly interrupted band, widely excavated anteriorly on each side, similar to that on fourth, sixth with two large suboval marks, notched on outer side, apical segment with two small yellow spots.

Among the species with entirely black thorax this is known by the deeply incised or divided lateral portions of abdominal bands, the entirely black scutellum, seventh segment with only

two small yellow spots, clypeus all yellow and apical lobes of abdomen elongate though broadly rounded.

Type: Male, No. 1742, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 26-28, 1917, at **Colton, California.**

29. **Anthidium lucidum** Cockerell, new species

Male: Length about 10 mm.; black, with lemon-yellow markings; hair of head and thorax white. Resembles *A. puncticaudum,* but smaller and more slender, with apical lobes of abdomen narrower, obtusely pointed, abdomen more shining, upper part of clypeus with two large hook-shaped black marks, lateral face marks going very little above level of top of clypeus, tubercles tipped with yellow, scutellum with two very small yellow marks, bands on tibiæ reduced and broken, first abdominal segment with only lateral spots, and these not very large, second segment with band like that on third, sixth with two hook-shaped marks, seventh all black. This is closer to *A. titusi* Ckll., differing by the entirely black scape, clypeal marks much deeper yellow, face marks lemon-yellow, abdominal bands, etc.

The California form which I have regarded as *A. titusi* has the scape black and the abdominal bands strongly yellow. It is between the two and perhaps better associated with *A. lucidum,* but additional observations are desirable. *A. angulatum* Ckll. is also related but clearly distinct.

Type: Male, No. 1743, Mus. Calif. Acad. Sci., collected by F. C. Clark, July 20, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 feet.

Anthidiellum Cockerell

Dianthidium subg. *Anthidiellum* Ckll., Bull. So. Calif. Acad. Sci., III, p. 3 (1904). Type *strigatum* Panzer.

Anthidium subg. *Cerianthidium* Friese, Europ. Bienen, Lief. 3, p. 304 (1923). For *strigatum* Panz. and *inerme* Fr. Type, now designated, *strigatum* Panzer.

This widespread and well characterized group may well stand as a genus. It includes such species as the following, described under *Anthidium* or *Dianthidium: Anthidiellum strigatum* (Panzer), Europe; *A. strigatum luteum* (Friese), Greece; *A. leucorhinum* (Ckll.), Siberia; *A. truncatiforme*

(Ckll.), Gold Coast; *A. tegwaniense* (Ckll.), S. Africa; *A. compactum* (Smith), S. Africa; *A. cucullatum* (Friese), Africa; *A. eiseni* (Ckll.), Lower California; *A. perplexum* (Smith), Georgia; *A. ehrhorni* (Ckll.), California; *A. robertsoni* (Ckll.), California; *A. gilense* (Ckll.), New Mexico.

30. **Anthidiellum robertsoni** (Cockerell)

Females: Kings River Cañon, Fresno Co., Calif., 5000 ft., May 25, and July 2 (Van Dyke); Mokelumne Hill, Calif. (Blaisdell); Colestin, Jackson Co., Oregon, July 30 (Van Duzee); Salt Lake City, Utah, July 1 (Van Duzee).

Males: Mokelumne Hill, Calif. (Blaisdell); Mill Creek Cañon, San Bernardino Co., Calif., Sept. 21 (Van Duzee). This species was discovered by Dr. Davidson at Rock Creek and Los Angeles, Calif.; it is surprising to find it extending its range to Oregon and Utah and well up into the mountains.

31. **Anthidiellum robertsoni citrinellum** Cockerell, new race

Male: Face marks bright lemon-yellow; a short yellow line on thorax behind each tegula; abdominal bands deep chrome yellow.

Type: Male, No. 1744, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 17, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft.

32. **Dianthidium sayi** Cockerell

Females: Salt Lake City, Utah, July 1, 1922 (Van Duzee).

33. **Dianthidium provancheri** Titus

Females: Cascada, Fresno Co., Calif., July 29, 1919, 6000 ft. (Van Duzee).

34. **Dianthidium singulare** (Cresson)

California: Meadow Valley, Plumas Co., 3000-4000 ft., June 13, one male (Van Dyke).

35. **Dianthidium singulare perluteum** T. & W. Cockerell

California: South Fork Kings River Cañon, Fresno Co., 5000 ft., July 5, 2 females, 2 males (Van Dyke). Described in 1904 from the female. The male has the end of the abdomen broadly trilobed, the seventh segment yellow without markings, the lateral lobes rounded, the middle one obtusely pointed and ferruginous at end.

36. **Dianthidium singulare melanognathum** Cockerell, new subspecies

Female: Marked like typical *D. singulare* from Nevada but mandibles black with a yellow spot at base; wings dusky; black mark on clypeus fusiform; coxal spines very long.

Type: Female, No. 1745, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 7, 1919, at **Huntington Lake, Fresno Co., California,** at 7000 ft.

37. **Dianthidium pudicum** Cresson

Females: Longmire, Rainier National Park, July 27 (Van Dyke); Huntington Lake, Fresno Co., Calif., 7000 ft., July 4, 1919 (Van Duzee); Strawberry Valley, Eldorado Co., Calif., August 14 (Van Dyke). The clypeus may be entirely black or may have a small light spot at each extreme side.

Males: Fallen Leaf Lake, Calif., July 17 (Van Dyke); Salt Lake City, Utah, June 27 (Van Duzee).

38. **Dianthidium consimile** (Ashmead)

Females: Ashland, Oregon, Aug. 2 (Van Duzee); Colestin, Oregon, July 30 (Van Duzee); also the following places in California: Cascada, 6000 ft., July 29 (Van Duzee); Bear Valley, San Bernardino Mts., Aug. (F. C. Clark); Cayton, Shasta Co., July 13 (Van Duzee); Mokelumne Hill, June (Blaisdell); Mill Creek Cañon, San Bernardino Mts., Sept. 21 (Van Duzee).

Males, all from California, as follows: Mokelumne Hill, June and Sept. (Blaisdell); Cascada, Fresno Co., July 29 (Van Duzee); Soboba Springs, Riverside Co., June 1 (Van Duzee); Mill Creek Cañon, San Bernardino Mts., Sept. 24 (Van Duzee); South Fork Kings River, July 8 (Van Dyke). The Kings River one lacks the yellow spot on mesopleura.

As in the allied *D. provancheri* the face markings are cream colored in the male, lemon-yellow in the female. The female clypeus has the middle broadly or narrowly black, there is a well developed triangular supraclypeal mark and a bar-like yellow mark below the anterior ocellus. In the male the clypeus is all light, the supraclypeal mark is a mere dot, and the mark before the ocellus is absent or represented by a very small line. The abdominal bands are broadly and deeply emarginate at sides posteriorly in the male but with much smaller emarginations or entire in the females. It seems difficult to associate as sexes insects so different, but I believe they certainly belong together.

Ashmead (1896) described what he called the female, but part of the description refers to the male, part to the female. In 1904 I reported what I took for *D. consimile,* but it was really *D. provancheri* Titus. In 1916 (Pomona Jl. Ent. and Zool., VIII, p. 63) I gave characters to separate the males of the two species.

39. **Dianthidium parvum** (Cresson)

Females: Logan, Utah, July 18 (Van Duzee). The clypeus has a cream-colored spot on each side; the scutellum is black with a pair of extremely small light marks.

Males: Logan, Utah, July 18 (Van Duzee); Ashland, Oregon, Aug. 2 (Van Duzee); and the following places in California: Cayton, Shasta Co., July 13 (Van Duzee); Strawberry Valley, El Dorado Co., Aug. 4 (Van Dyke); Huntington Lake, Fresno Co., 7000 ft., July 26 (Van Duzee); Bear Valley, San Bernardino Mts., Aug. (F. C. Clark); Mill Creek Cañon, San Bernardino Mts., Sept. 21 (Van Duzee).

40. **Dianthidium parvum baculifrons** Cockerell, new race

Female: Face marks light yellow including lower lateral corners of clypeus, so that the black part of the clypeus rapidly narrows apically; a short yellow bar below middle ocellus; entire margin of scutellum broadly, and axillæ, yellow; lateral emargination of abdominal segments short, deep and rounded; scopa shining white (distinctly yellow in *D. parvum*).

This is intermediate between *D. parvum* and *D. provancheri*, differing from the latter by the paler face markings, with more black on clypeus; hind tibiæ black with a large pale yellow patch at base above, and sixth abdominal segment entirely black. It should perhaps be considered a form of *D. provancheri*, or a distinct species. Titus described only the male of *D. provancheri*.

Type: Female, No. 1746, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 5, 1917, at **Soboba Springs, Riverside Co., California.**

Callanthidium Cockerell, new genus

Outer recurrent nervure going beyond end of second cubital cell; no pulvillæ on feet. On account of these characters I thought to refer these bees to the neotropical genus *Hypanthidium*, in which certain African and Indian species have already been placed. These large North American forms are, however, strongly divergent, not only by their size, but especially in the armature at the apex of the abdomen. The sixth segment is deeply emarginate in the middle in the female and the apex of the male abdomen shows a median spine and large lateral lobes. There is some affinity with *Dianthidium*, to which genus I wrongly referred the type species in 1914. Type, *C. illustre (Anthidium illustre* Cresson).

41. **Callanthidium illustre** (Cresson)

California: Yosemite Valley, June 21 (Van Dyke); Soboba Springs, Riverside Co., June 2 (Van Duzee); Poway, San Diego Co., May 24 (Blaisdell); Meadow Valley, Plumas Co.,

3500-4000 ft., June 21 (Van Dyke); Bear Valley, San Bernardino Co., July 13 (F. C. Clark); Claremont (C. H. Muzzall); Colton, May 26 (Van Duzee); Cayton, Shasta Co., July 13 (Van Duzee).

The next species is closely allied but is readily separated by the black femora.

In 1904 I described a supposed species, *Anthidium serranum,* from Rock Creek, California. It was recognized as valid by Swenk in 1914, but I now consider it only a variation of *Callanthidium illustre,* to be called *C. illustre serranum.* It is not even certain that it is a valid race.

42. **Callanthidium conspicuum** (Cresson)

California: Fallen Leaf Lake, July 17 (Van Dyke). Oregon: Fremont National Forest, Klamath Co., 5000 ft., June 18 (Van Dyke).

I have an apparently authentic female of *Dianthidium balli* Titus, labelled "Blydenburgh." On comparison with *C. conspicuum* it proves to be identical.

43. **Callanthidium formosum** (Cresson)

Oregon: Crater Lake, 7000 ft., July 17 (Van Dyke).

Described (under *Anthidium*) from Colorado. There are no pulvillæ and the species is near to *C. conspicuum,* but easily separated by the end of the male abdomen, the emargination of which is broader than Cresson's figure shows. I had suggested that this might be the male of *Dianthidium cressonii* D. T., but that has pulvillæ, much darker wings, and the first recurrent nervure ending far from base of second cubital cell (practically at basal corner in *C. formosum*).

44. **Callanthidium formosum pratense** Cockerell, new species

Male: Yellow stripes on head above nearly meeting in middle line; yellow marks on mesothorax in front larger; tegulæ with very large yellow patch; scutellum with a pair of yellow stripes; first abdominal segment with the yellow marks produced in hook-like form; band on third

segment narrowly continuous in middle, and not notched behind; seventh segment yellow right across, and the median spine only about half as long as the distance between it and the lateral lobes. As in the typical form, the lateral lobes are pointed, with the extreme apical face straight or slightly concave.

Type: Male, No. 1747, Mus. Calif. Acad. Sci., collected by Dr. E. C. Van Dyke, June 17, 1924, at **Meadow Valley, Plumas Co., California,** between 6000 and 7000 feet.

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XVI

STUDIES IN THE TENEBRIONIDÆ, NO. 2

(COLEOPTERA)

BY

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The first number of the present studies appeared in the Entomological News of January, 1918 (Vol. XXIX, p. 7.). The new species and subspecies of Eleodes described below have accumulated since the publication of my Monographic Revision of the Eleodiini (Bull. 63, U. S. Nat. Mus.) in 1909. The material studied since then has cleared up the doubtful status of several of the phases given at that time. Mr. Leng in a foot-note (p. 227) in the Catalogue of the Coleoptera of America North of Mexico, remarks that I have more recently elevated several such names to higher rank, "the original presumption in such cases having been apparently erroneous."

In the mass of heterogeneous material upon which I based my monograph, there were numerous instances in which the specimens were too few for a correct and definite understanding of the relationships; as a result, many subspecies and races were not recognized and unwittingly considered as *forms*,—not wholly from ignorance in many cases, but more truly as acts of conservatism, I having believed it to be more logical and truthful to raise than to lower a grade, whenever more positive data warranted it.

From the standpoint of taxonomy, the solution of the question of specific relationship is not going to come from the study of dried museum specimens, but must be the result of careful ontogenetic and ecologic studies of large series of specimens collected in the different geographic regions. Such research must be pursued with untiring zeal if we are to arrive ultimately at some conception of the laws governing the divergence of organisms.

The raising of certain *forms* to a definite grade does not invalidate the conception of such intra-specific groups, for even then the specific aggregates will be made up of variants, as no two individuals of any species can be exactly alike as regards size, form, sculpturing and color, no matter how much restricted taxonomically. With Dr. E. C. Van Dyke, I prefer to use the term "phase" in a generic sense to include all variants of a species, subspecies or variety. When a species is limited taxonomically the intra-specific, intra-subspecific or intra-varietal variants can be grouped according to size, form, sculpturing or color, each group constituting a *form*. These are really ecological groups. I expressed these same ideas in my monograph.

In 1909 I presented the conception of *forms* as a means of directing attention to the variation within specific units so as to make them objects of research. I *advised that* forms *should not be given a place in a check-list,* for on the very face of the matter they are absolute synonyms according to the author and from the standpoint of taxonomy. We must have laws and rules of guidance, otherwise everything passes into confusion, and yet to enforce them rigidly or literally may retard science rather than advance it. The enforcement of laws or the application of rules must be tempered by good judgment, this is absolutely necessary, for no law or rule is strictly applicable in all cases; hence the need of flexibility in the application of a rule. Certain recent changes in our nomenclature have been founded on paleographic facts much to the confusion of other branches of science.

A word or two regarding extremists versus the intermediate path. Conservatism, when extreme, retards the progress of science. Most of this is due to the exercise of the personal equation rather than to biological inquiry. A species relegated

to synonymy is supposed to be defunct for all time and yet some synonymical lists are rich in research material. The other extreme usually overrates biological facts, but the result more than balances the harm done by the stimulus it gives to discussion and research. Why not pursue the more logical and sane path,—bury the personal equation and let intensive research dictate the biological data; the deductions will then be both progressive and scientific.

Forms may be said to constitute ecological groups, for the units of a species exhibit individual differences which are very evidently due to environment and not to reactions in the germ plasm. It may be admitted that environmental conditions will affect the germ plasm in the course of centuries. Environmental conditions are constantly changing and therefore unstaple: They change from day to day, from month to month, and from year to year; first warm then cold, dry and then wet, over a whole region or any part of a region, even to small and restricted areas. That is why one season yields notable variations and the next something still different.

A consideration of the principle ecological factors capable of bringing about variations in size, form, sculpturing and color in organisms, includes temperature, humidity, quantity and quality of food, coupled with geographical position. Any one taking cognizance of these facts should eliminate if possible all individual variations *(forms)* of known or described species, subspecies and varieties before describing any of them as new to science. Let it be kept in mind that the earth is Nature's great experimental laboratory and that it is an infinite field for research.

The limitation of species, subspecies and varieties is quite arbitrary in the present state of our knowledge. A species as at present defined, with its subspecies and varieties constitutes a specific complex. I believe that all subspecies and varieties should be recognized and named as they constitute taxonomic subgrades. The main idea in doing this is to make them objects of research. The definition of a species is too well known for me to repeat it, but I would like to make known what I understand by subspecies and variety or race. The usual encyclopedic definition leads the student in a circle so that he usually knows just as much after his investigation as he did

when he began. My definitions have been formulated from observations in the field.

I assume that I am dealing with a specific phase worthy of subspecific grade whenever a series of specimens has been collected in some particular geographical region apart from the type and, as a whole, presents some notable difference in form, size, sculpturing or color from the type.

I assume likewise that a variety (race) is to be recognized when a series of specimens presents some minor but constant difference in size, form, sculpturing or color from the type, and usually inhabits the same geographical region, but in some areas the varietal phase may predominate. A subspecies or variety interbreeds with the type if inhabiting the same geographical region or area. The regions of distribution of type, subspecies and variety may overlap and this accounts in part for the confusion which exists regarding what constitutes a subspecies or variety. I believe that ontogenetic research must decide the relationships in the Insecta. The student in the field must work out the distributional and seasonal phases.

Forms in the sense defined above should be recognized, studied and properly placed in collections, and discussed in current papers and monographs, but not given in a check-list.

The following new species, subspecies, and varieties are presented at the present time:

1. **Telabis nevadensis** Blaisdell, new species

Form elongate oblong-oval, a little more than twice as long as wide, moderately convex. Color piceous brown, dark rufous beneath, legs paler; luster dull to somewhat shining.

Head a little transverse, sides moderately convergent and feebly arcuate before the eyes, the latter somewhat prominent and coarsely faceted; epistoma slightly produced, arcuato-truncate at apex, sides briefly oblique from the shallow emarginations; front very slightly convex, very feebly and broadly impressed laterally within the sides, moderately and discretely punctate, punctures somewhat coarser, deeper and more or less coalescent on the epistoma; vertex more or less strigose. Antennæ long and slender.

Pronotum nearly twice as wide as long; apex moderately emarginate, angles obtuse and blunt; base feebly bisinuate, marginal bead rather broad and flat in middle third; basal angles obtuse and distinct; sides evenly and moderately arcuate, feebly convergent anteriorly, margin rather thin

and narrowly reflexed, slightly crenulate; disk moderately convex, discretely punctate; punctures smaller in middle third, thence somewhat coarser and more oval, with their margins quite distinct and not coalescent; sides narrowly impressed but rather more widely so toward the basal angles. Propleura with a few scattered hairs; rather coarsely, but not densely punctate, punctures shallow; intervals somewhat prominent longitudinally.

Elytra oblong, about a half longer than wide, sides parallel and feebly arcuate, apex broadly rounded, humeri obtuse and not in the least prominent, although somewhat exposed; disk moderately convex, finely and subasperately punctate, punctures somewhat confused at base, sides and apex, series quite distinct in the central area.

Sterna sparsely and not very coarsely punctate; punctures shallow; mesosternal epimera impunctate; transverse metasternal ante-coxal line well defined and almost entire. Abdomen moderately evenly convex, finely and very sparsely punctate along the middle, rather more coarsely so laterally; under surface of the body clothed with scattered hairs.

Length (types) 6-6.5 mm.; width 2.4-2.8 mm.

Holotype, male, and *allotype,* female, in my collection. *Paratypes* in the collection of Mr. Warren Knaus and in that of the author.

Type locality: Las Vegas, Nevada, collected July 31, 1921. A series of five specimens.

This species evidently falls into the series with Casey's *uteana* and *amica,* both from Utah. In *nevadensis* the punctuation of the head and pronotum is discrete, not very dense (rather more abundant in the female), shallow and scarcely asperate, not muricate; the vertex of the head may be more or less longitudinally strigose. According to Casey, *uteana* is piceous black in color and *amica* is pale testaceous, and he makes no mention of the vertex of the head being strigose in either species.

2. **Eleodes quadricollis lassenica** Blaisdell, new subspecies

Form and sculpturing similar to that of *quadricollis* Esch., but more strongly and densely punctate throughout. Color intense black.

Pronotum more arcuately and strongly declivous laterally, and as a result more strongly convex from side to side. Anterior spurs of the protibiæ more elongate in both sexes.

Male: Narrower elongate-oval. Female: Ovate, sides more arcuate; elytra just noticeably inflated. Sexes otherwise as in *quadricollis.*

Length (types) 17-18.5 mm.; width 7-8.5 mm.

Holotype, female, and *allotype,* male, in the author's collection.

Type locality: Martin's Spring, Lassen County, California. Section 14, Tp. 31 N, R. 9 E. Collected by Mr. J. O. Martin, on July 10th, 1922. A single pair.

In *humeralis* Lec. the pronotal marginal bead is visible throughout the length when viewed vertically from above; in *quadricollis* and related species the lateral marginal bead is more or less invisible from above. The main diagnostic characters of *lassenica,* are the denser, stronger sculpturing and less elongate form.

3. **Eleodes parowana** Blaisdell, new species

Form oblong-oval to oblong-ovate, rather strongly convex, a little more than twice as long as wide. Color deep black and feebly shining.

Head moderate in size, densely punctate before the eyes; vertex sparsely punctate; sides arcuate at the supra-antennal convexities, thence straight and convergent to the frontal angles, the latter obtuse; epistoma broadly and evenly emarginate; frontal sutures not evident. Antennæ rather stout and moderate in length, tenth joint transversely oval, the three-jointed club very slightly wider than the preceding joints.

Pronotum quadrate to slightly transverse, widest at apical third; apex truncato-emarginate in moderate circular arc; sides quite strongly arcuate in apical half, thence straight, oblique and moderately convergent to base, marginal bead fine; apical angles nearly rectangular; base transverse and the angles obtuse but not in the least rounded; disk moderately strongly convex, declivous laterally, finely and rather densely punctate, punctures slightly larger laterally, those of the central area being a little more widely separated.

Elytra oval, base sinuate lateral to the scutellum, the latter triangular; humeri obtuse and rather distinct; sides evenly arcuate, apex moderately narrowly rounded; disk costate, costæ moderately convex, smooth and sparsely punctulate, intervals finely and more abundantly, irregularly punctate; punctures on the apical declivity slightly muricate. Legs moderate in length and stoutness, as well as rather densely sculptured. Tarsi moderately stout.

Male: More elongate oblong-oval, front of head more convex. Pronotum subquadrate, widest at middle as viewed from above. Elytral *intervals alternately costate.* Abdomen very slightly oblique to the sterna, strongly impressed at middle of first two segments, inter-coxal process broad. Anterior spurs of the protibiæ produced and moderate in stoutness.

Female: Oblong-ovate, broader. Pronotum wider than long, widest in front of the middle. Elytra costate as in the male with the *intervening intervals* more or less convex, sides with an incipient margin; apical declivity arcuate and moderately abrupt. Abdomen rather strongly convex. Anterior protibial spur produced and thickened as in the female of *quadricollis*.

Length (types) 15-16.5 mm.; width 6-7.8 mm.

Holotype, female, and *allotype*, male, in my collection. *Paratypes* in that of Mr. Warren Knaus of McPherson, Kansas. Collected on "the Mammoth," at top of Parowan Mountains, Utah, on July 12-22, 1921, at an elevation of 10,000 feet, by Mr. Knaus, while on the Mininger-Hoover Expedition.

Four specimens studied. The elytral sculpturing of *parowana* is unique in the *quadricollis* section of the subgenus Melaneleodes. Extending backward from the humeri is an angulation indicating the beginning demarcation of the inflexed sides from the dorsum of the elytra, as observed in *tricostata* and *pedinoides*, although the elytra are strongly convex and not depressed as in the latter species. In *parowana* the anterior protibial spurs are produced and stout as in *quadricollis*. In the *tricostata* group the spurs are produced but they are not so stout. This new species is a most interesting and surprising addition to the subgenus Melaneleodes.

4. **Eleodes parowana mimica** Blaisdell, new variety

Mimica resembles *parowana* in most characters, but differs, chiefly in the character of the sculpturing, as follows: *Form* rather more robust, integuments rather denser. Elytral sculpturing more strongly developed and like that observed in the oval form of *tricostata;* alternate intervals strongly convex, surface scabrous from rather fine and quite densely placed muricate punctures; the intermediate intervals may become feebly subcostate.

In *parowana* the elytral punctures are very fine and quite equal throughout, scarcely at all or very feebly asperate at times. In other words in *parowana* the punctuation resembles that observed in typical *porcata* Casey, except that the punctures are equal in size. In *mimica* the punctuation is like that of *tricostata* Say. The pronotum and the anterior tibial spurs

are as in the *quadricollis* group. In the *tricostata* group the pronotum is distinctly transverse.

Length (types) 17-16 mm.; width 6.5-7 mm.

Holotype, female, and *allotype,* male, in my collection. *Paratypes* in that of Mr. Tanner.

Type locality: Bryce Cañon, Utah. Collected by Mr. Vasco M. Tanner on July 27th, 1922.

5. **Eleodes fuscipilosa** Blaisdell, new species

Form rather elongate subfusiform-ovate to ovate, slightly depressed above and a little more than twice as long as wide. Color black throughout, luster rather dull.

Head rather small, front very feebly convex, impressions obsolete, densely and rather finely punctate, punctures much sparser on the vertex; epistoma subtruncate at apex, sides quite straight and slightly convergent anteriorly, angles distinct and rather narrowly rounded, supra-antennal convexities feeble. Eyes rather narrow. Antennæ moderate in length, gradually and very slightly incrassate in outer joints; joints four to seven longer than wide and obconical, eighth triangular, ninth and tenth slightly transverse, eleventh obovate and rather obliquely truncate at tip.

Pronotum subquadrate, relatively small, widest at about the middle, base and apex subequal; apex quite truncate and the angles very distinct, obtuse and not prominent anteriorly; sides rather evenly but not strongly arcuate, almost straight posteriorly and moderately convergent to base, marginal bead fine; base feebly and broadly arcuate, the angles obtuse; disk rather evenly convex, most strongly so laterally and declivous as usual in the *quadricollis* group, finely and almost evenly punctate, punctures well separated.

Elytra suboval, base scarcely wider than the pronotal base, slightly emarginate and adapted to the pronotal base; sides moderately arcuate, convergently so to apex in apical fourth, the apex rather narrowly rounded; disk more or less depressed, more or less moderately and more abruptly rounded into the deflexed sides, rather abruptly and arcuately declivous posteriorly; surface quite discretely muricato-granulate, granules small and shining at summit, not well developed in the central sutural area, irregularly placed, but with a suggestion of a serial arrangement when viewed longitudinally from behind; each granule with a short nearly erect and somewhat stiff brownish hair which is scarcely conspicuous. Epipleura rather narrow and but slightly wider toward base.

Sterna finely and rather densely muricato-punctate. Abdomen finely and rather closely punctate; segments rather strongly convex antero-posteriorly. Legs moderate in length and stoutness.

Male: Narrower, subfusiform-ovate. Pronotum about as wide as long; antennæ slightly stouter; elytral disk less depressed. Abdomen slightly oblique to the sterna; first and second segments flattened in middle third, with a median longitudinal impression. Tarsi rather stout; first protarsal joint not noticeably thickened at apex beneath. Anterior protibial spur distinctly lengthened and stouter than the posterior.

Female: Broader and ovate. Pronotum slightly wider than long. Antennæ rather less stout. Elytral disk noticeably flattened. Abdomen horizontal and moderately strongly convex. Tarsi rather less stout. Anterior protibial spur very distinctly enlarged.

Length (types) 14-16 mm.; width 5-8 mm.

Holotype, female, and *allotype*, male, in my collection, both collected at Parowan, Utah, at an elevation of 6000 ft., on July 24-25, 1921, by Mr. Warren Knaus while on the Mininger-Hoover Expedition.

Fuscipilosa belongs to the *quadricollis* section of the genus on account of the enlarged anterior protibial spurs. It differs from all others of the group in the relatively small head and pronotum and brownish pubescence of the elytra. It should follow *coloradensis* in the list of species.

6. **Eleodes reducta** Blaisdell, new species

Form oblong-ovate, about two and a third times longer than wide and moderately strongly convex. Color deep black, luster somewhat shining.

Head moderate in size, front very slightly convex, impressions feebly indicated, most marked within the supra-antennal convexities; densely and irregularly punctate, with small impunctate areas, punctures rather small, becoming still smaller and sparser on the vertex; sides rather arcuately prominent over the antennal base, thence becoming sinuate, straight and obliquely convergent to the narrowly rounded epistomal angles; apex of the epistoma broadly and feebly emarginate. Eyes narrow. Antennæ moderate in stoutness and length, attaining the pronotal base; joints four to eight slightly longer than wide, ninth about as long as wide and subglobular, tenth slightly wider than long, eleventh short obovate and truncate at tip.

Pronotum subquadrate, widest at about the middle; apex truncate in circular arc, apical angles obtuse and distinct; sides broadly and moderately arcuate, becoming straight or slightly sinuate to base, marginal bead very fine; base broadly but not strongly arcuate, sometimes feebly sinuate

at middle; basal angles obtuse; disk evenly convex, more strongly so laterally, marginal bead more or less visible from above, punctures small and distinct, more or less regularly placed and not crowded.

Elytra oval, less than twice as long as wide; base feebly emarginate and adapted to the pronotal base, slightly wider than the latter, humeri obtuse and not prominent; sides broadly and moderately arcuate, converging to apex in apical third, the latter rather narrowly rounded; disk moderately convex on the dorsum, more strongly so laterally but not rounding broadly into the moderately inflexed sides, punctures feebly muricate, rather evenly distributed, although slightly denser at the sides and apex where they become more strongly muricate, irregularly placed, with unimpressed striæ evident; rather abruptly and arcuately declivous posteriorly.

Sterna more or less finely muricato-punctate; abdomen more sparsely punctate. Legs of moderate length and stoutness.

Male: Narrower, pronotum about as wide as long. Abdomen slightly oblique to the sterna, first two segments flattened in the central area, with a slight median longitudinal impression. Protarsal plantar grooves open, first joint not noticeably thickened at apex beneath.

Female: Broader, pronotum a little wider than long. Abdomen horizontal and rather strongly convex. Protarsal plantar grooves closed on the first joint, the latter prominent at apex beneath and set with small black spinules. Anterior protibial spurs enlarged and thickened.

Length (types) 15-17.5 mm.; width 6-7.5 mm.

Holotype, female, and *allotype*, male, in my collection. A female *paratype* is in the collection of Mr. Vasco M. Tanner, Dixie Normal School, St. George, Utah. Collected near Cove Fort on the Beaver County line, Utah, June 20th, 1922, by Mr. Tanner.

Reducta is related to *humeralis*, but at first sight resembles *obsoleta* forma *punctata*, and is readily separated from it by the enlarged anterior protarsal spurs of the female. The form is less robust than in *humeralis* and the sculpturing is less dense and more muricate; in *humeralis* the sculpturing is dense, more granular and very minutely muricate, the lateral pronotal margin is distinctly visible from above as a result of the disk being less arcuately declivous at the sides. *Coloradensis* is more robust and less elongate. The elytra in *fuscipilosa* are clothed with short brownish hairs, while in *concinna* the elytral sculpturing consists of small discrete shining granules.

7. **Eleodes mazatzalensis** Blaisdell, new species

Form elongate-ovate, somewhat depressed, a little more than twice as long as wide. Color deep black and shining.

Head moderate in size, about as long as wide, almost flat, feebly impressed laterally; punctures moderate in size, not crowded, slightly smaller and somewhat sparser on the vertex. Antennæ moderate in length, slightly compressed distally, scarcely at all incrassate; third joint very little longer than the fourth and fifth taken together; fourth joint just the least longer than the fifth; fifth, sixth, seventh and eighth subequal in length, last two very little stouter and feebly triangular; ninth and tenth oval, scarcely longer than wide; eleventh oblong-oval, a little longer than wide and rather broadly rounded at apex.

Pronotum about two-sevenths wider than long, widest slightly in advance of the middle; sides rather broadly arcuate in anterior three-fourths, thence moderately convergent and feebly sinuate to base, marginal bead fine; apex truncate; apical angles obtuse and distinct; base very feebly arcuate and about equal to the apex; basal angles obtuse, almost distinct; disk moderately and evenly convex from side to side, feebly so antero-posteriorly, quite strongly declivous laterally behind the middle, noticeably so at the apical angles, surface finely and sparsely punctulate, slightly alutaceous.

Elytra oval, feebly wider posteriorly, sides broadly arcuate, apex moderately broadly rounded; disk with distinct lines of punctures, the latter moderate in coarseness, rather closely but irregularly spaced, intervals with an irregular line of sparsely placed punctules; surface rather depressed in the central area, almost vertically declivous posteriorly. Humeri small and acute.

Sterna quite densely punctured. Abdomen finely punctato-rugulose; horizontal in both sexes. Legs moderate in length; the posterior noticeably longer in relative proportion than the anterior.

Male: Somewhat narrower. Abdomen feebly flattened along the middle of the first three segments. Inner spur of the anterior tibiæ a little stouter than the outer; plantar grooves open on all the tarsi, except at the tip of the first joint of the anterior tarsi, where it is closed by a transverse row of coarse blackish spinules.

Female: Slightly broader. Antennæ relatively a little longer; abdomen evenly but not strongly convex.

Male, length 14 mm., width 6 mm.; female, length 18 mm., width 7 mm.

Holotype, male, and *allotype*, female, in the collection of the Entomological Department of the Agricultural College of Cornell University, Ithaca, New York. *Paratype*, female, in the author's collection. Types bear the label: Lot 445, Sub. 3.

Type locality: Mazatzal Mountains, Arizona, collected Sept. 1-3.

The anterior tarsi are imperfect on both types, only the first and second joints being present. The sexes are similar in form, and suggestive of the females of *dissimilis* Blais. In the latter the plantar grooves of the anterior tarsi are open in both sexes, and the elytral punctuation is finer. The tarsal characters and tibial spurs correlate *mazatzalensis* with the *carbonaria* section of the subgenus Melaneleodes. A second female in the Agricultural College collection is more finely sculptured.

8. **Eleodes coloradensis** Blaisdell, new species

In my Monographic Revision of the Eleodiini this species was recorded as a form of *humeralis* Lec. (Forma *tuberculo-muricata)*. The collecting of recent years has contributed much toward the elucidation of the relationship between certain phases that were of dubious status at the time the above monograph was written. I made no mistake, however, in considering the above species as related to *humeralis* Lec. I gave simply the relationship as I interpreted it from the meager material that was before me at that time. I will now present a modified description considering it a species:

Form robust and less elongate than *humeralis* Lec. Pronotum more arcuately declivous laterally, with the margins more or less invisible from above. Elytra more coarsely and strongly sculptured, subtuberculately muricate with the punctures much sparser than in *humeralis.*

Length (types) 16-16 mm.; width 5.5-7 mm.

Holotype, female, and *allotype,* male, in my collection. Both types were collected in Colorado, the male by C. V. Riley.

In *coloradensis* the elytral granules are larger and more like tubercles. It is separated from *humeralis* by the more robust form, sparser and coarser sculpturing of the elytra, as well as the more abruptly declivous sides of the pronotal disk. It is more robust than *fuscipilosa,* with a relatively larger head and pronotum and the absence of distinct hairs on the elytra. In *rileyi* Casey the elytral sculpturing is sparser and not asperate.

9. **Eleodes concinna** Blaisdell, new species

This species was considered as *humeralis* forma *granulato-muricata* in my Monograph (Bull. 63, U. S. Nat. Mus., 1909). Many specimens collected in Nevada, Lassen and Plumas counties in California have been studied and compared during the last decade. My present conviction is that it should have full specific rank. *Concinna* may be defined as follows:

Form elongate, oblong-ovate to ovate, less robust and more sparsely sculptured than *humeralis* Lec. Elytra moderately convex on the dorsum, sides more or less broadly rounded; disk less densely sculptured with small muricate granules which are shining at their summit.

Length (types) 15.5-16 mm.; width 5.8-7 mm.

Holotype, male, and *allotype,* female, in my collection. The male was collected in Lassen County, California, and the accompanying female was taken at Carson, Nevada.

Distribution: Nevada (Verdi, April — Blaisdell; Carson City, July; Reno,—Wickham; Utah,—Riley). California (Lassen County; Plumas County, April 25th,—Essig.)

The specimens from Lassen County, California, "have the elytra discretely granulate; each granule under low power of magnification is polished and shining, under high power the granules are minutely pointed at their summit." This form of sculpturing constitutes the typical phase.

10. **Eleodes wenzeli** Blaisdell, new species

Form oblong-oval with elytral disk flattened. Color deep black, luster somewhat alutaceous, surface smooth, almost glabrous.

Head relatively small, front very slightly convex, impressions obsolete, punctures fine, discrete, slightly coarser on the epistoma; sides feebly arcuate over the antennal fossæ, thence feebly sinuate and straight, converging to the narrowly rounded epistomal angles, apex of the epistoma feebly and broadly emarginate. Antennæ moderate in length, joints four to seven slightly longer than wide, subequal, seventh slightly shorter, terminal joint not thickened, as long as wide, subglobular and slightly compressed.

Pronotum subquadrate, as wide as the elytra, widest slightly in advance of the middle; apex slightly emarginate in feeble circular arc; apical angles subacute and slightly prominent anteriorly; sides broadly and moderately arcuate in anterior two-thirds, thence less so, straight

and very moderately convergent to the basal angles, marginal bead distinct and moderately fine; base very feebly arcuate; basal angles obtuse; disk moderately and evenly convex, finely and not closely punctate, basal impressions obsolete.

Elytra oblong, narrowing posteriorly, about twice as long as wide; base feebly emarginate and adapted to the pronotal base, humeri slightly exposed, small and obtuse; sides broadly arcuate, subparallel, gradually converging to apex in apical third, apex rather narrowly rounded; disk flattened on the dorsum, moderately convex, rather abruptly rounding into the moderately inflexed sides, arcuately and rather obliquely declivous posteriorly, finely, not closely and quite evenly punctate, punctures not subasperate, obsoletely striate. Epipleura very gradually widening toward base and comparatively narrow.

Sterna and abdomen shining, feebly and not densely sculptured. Legs moderately long, femora rather stout; tarsi somewhat slender.

Male: Form oblong, parallel; elytra flattened on the dorsum. Abdomen oblique to the sterna and impressed in the middle third of the first two segments.

Length 19 mm.; width 8 mm.

Holotype, male, in the author's collection, taken in the Chisos Mountains of Texas, on July 24, by Mr. H. A. Wenzel, after whom the species is named.

Wenzeli belongs to the *pedinoides* group of the subgenus Melaneleodes. It can readily be recognized by its smooth, finely sculptured integuments and alutaceous luster. In *speculicollis* the pronotal disk is polished and shining, the elytra rather strongly sculptured. *Neomexicana* is duller in luster and the elytra are rather densely but not coarsely subasperately sculptured, while *pedinoides* is larger, more shining and the elytra striate; *asperata* Lec. has the elytra more strongly and very distinctly muricate at the sides and on the apex.

11. **Eleodes speculicollis** Blaisdell, new species

Similar in form to *neomexicana* Blais. Surface more shining, the pronotal disk polished.

Pronotum evenly and moderately convex, basal impressions feeble or obsolete; base broadly and not strongly emarginate at middle; disk with several fortuitous impressions, not present in the males.

Elytra moderately feebly convex on the dorsum, laterally rather less broadly rounded than in *neomexicana;* surface obsoletely striate, intervals indicated as faint subglabrous lines, punctures confused, rather dense

and somewhat fine, not at all granulato-muricate, except slightly so on the apex. Legs rather less stout. Otherwise as in *neomexicana* Blais.

Length (types) 20-21 mm.; width 7-9 mm.

Holotype, female, No. 1812, and *allotype,* male, No. 1813, Mus. Calif. Acad. Sci., collected by C. D. Duncan, July 9, 1921, on **Livermore Peak, Davis Mountains, Texas.** *Paratypes,* two males, one in the collection of the Academy and one in that of the author, same data.

Speculicollis is readily separated from *neomexicana* by its shining integuments and polished pronotal disk and smoother elytral sculpturing. Three males and one female have been studied. It is the author's belief that *neomexicana* Blais. should be considered a distinct species and not a race of *pedinoides* Lec.

12. **Eleodes obscura glabriuscula** Blaisdell, new subspecies

Similar to *dispersa* Lec. Color deep black, surface smooth and shining.

Elytral sculpturing consisting of striæ of coarser punctures; intervals with a single series of similar punctures that are more widely spaced with the surface slightly rugose laterally and on the apex, where the punctures become more or less asperate and the sculpturing confused; punctures simple on the dorsum.

Sterna and abdomen polished.

Male narrower as in *dispersa.*

Female broader and rather less elongate.

Length (types) 30-28 mm.; width 10-11 mm.

Holotype, female, No. 1814, Mus. Calif. Acad. Sci., collected by C. D. Duncan, July 12, 1921, at **Alpine, Texas.** *Allotype,* male, collected by C. D. Duncan, July 9, 1921, on Livermore Peak, Davis Mountains, Texas.

In the form *deleta* Lec. the elytral sulci are obsolete, except at the sides behind the middle, where some faint traces of them are seen; the punctures are submuricate and arranged in striæ, distinct on the dorsum, but confused at the sides; between the rows are distinct punctures as in *obscura* Say; posteriorly abruptly declivous and furnished with rows of tubercles, alter-

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nately large and small. In *arata* Lec. the elytral sulci are deeper than in *sulcipennis* Mann. and therefore quite different from *glabriuscula*.

13. **Eleodes hispilabris connexa** Lec.

This subspecies was unknown to me in nature when my monograph was written. A couple of years ago a pair of specimens collected at Albuquerque, New Mexico, came into my possession. Both sexes are narrower than in *hispilabris* Say, and the integuments are denser. Le Conte's description very correctly defines the subspecific characteristics: "Elongate, black and bright, thorax moderately punctulate with sides rounded, anterior angles acute and slightly prominent; basal angles obtuse. Elytra elongate oval, intervals subconvex and more or less rugose, subacute posteriorly." Type locality, Prairie Paso, Texas. It is a distinct subspecies.

14. **Eleodes hispilabris nupta** Say

This variety of *hispilabris* Say was first described from specimens taken at Laredo to Ringhold Barracks, Texas. It is less elongate, more robust and the elytra are more or less inflated, sometimes markedly so. Many specimens are more or less broadly rufous along the elytral suture. *Nupta* has been heretofore quite rare, not many specimens having been collected in recent years.

I have recently received the loan of twenty-four specimens from the entomological collection of the University of Kansas, through the kindness of Prof. R. H. Beamer; also seven specimens from Mr. Warren Knaus of McPherson, Kansas. Both series were collected on the sand hills about Medora, Kansas. Those from the University collection were taken on April 13th, 1925, with the exception of one specimen which was collected in Sherman County, Kansas, at an elevation of 3600 feet by Mr. F. X. Williams. The latter specimen is quite identical with one in my own collection secured at Fort Supply, Oklahoma. Those loaned to me by Mr. Knaus were in part also collected in April, on the 25th, the others on September 17th, 1916.

A pair was first submitted to me for identification and I thought that they represented a new race of *hispilabris* Say, until I saw the entire series. *Nupta* Say has a wider distribution than was at first believed. The body form of the Kansas series is more like that of the females of the *carbonaria, omissa* and *quadricollis* sections of the subgenus Melaneleodes Blais. The small prothorax, shorter and broader, and the more or less inflated elytra gives quite a different facies from that of the typical *hispilabris* Say.

The specimens collected in September are more decidedly red along the suture than those collected in April. This may be due to a somewhat immature condition or to retardation and alteration in the chemical constitution of the pigment. The darker individuals appear to have firmer integuments.

15. **Eleodes dentipes montana** Blaisdell, new variety

Form and color of *dentipes*. Pronotum very finely but not densely punctate. Elytra with unimpressed striæ of rather coarse and closely placed punctures, with single interstitial series of slightly smaller and rather more widely spaced punctures; series not confused laterally or apically.

Length (types) 24-23 mm.; width 8.1-9.2 mm.

Holotype, female, and *allotype,* male, in my collection. Collected in the Santa Cruz Mountains, near Mt. Hermon, Santa Cruz County, California, on July 20, 1922.

In *dentipes* Esch. the pronotal punctuation is a little coarser and that of the elytra finer and *confused* laterally and apically. In *confinis* Blais. the punctuation is still finer and the sides of the pronotum are straight posteriorly and not in the least sinuate before the basal angles. In *perpunctata* Blais. the form is more elongate, the punctuation variable and the sides of the pronotal disk are impressed, dull and granulate within the bead. *Dentipes* and *montana* have the pronotal disk glabrous and transversely convex from bead to bead. *Tularensis* is more alutaceous, the legs and antennæ are slender and the

elytra are oval, the humeri being obsolete. In the race *marinæ* Blais, the elytral punctures are diffuse and of equal size throughout and the form is rather more robust.

16. **Eleodes dentipes tularensis** Blaisdell, new subspecies

Form elongate, subfusiform oval. Color black, luster rather dull.

Head about a third wider than long, feebly convex and with very shallow impressions within the antennal convexities; finely and sparsely subasperately punctate, punctures rather dense laterally and on the epistoma. Antennæ rather long, moderately slender, last three or four joints slightly wider.

Pronotum about a seventh wider than long, base quite equal to the apex, the latter feebly emarginate in circular arc, finely or obsoletely beaded; base feebly arcuate and finely beaded; sides broadly and rather moderately arcuate, briefly sinuate before the basal angles which are distinct but feeble; apical angles small, dentiform and more or less everted; disk rather evenly and moderately convex, finely and sparsely punctate, scarcely denser laterally, not impressed along the margin but narrowly opaque with granulate punctures, marginal bead fine, rather thin and very feebly reflexed. Propleura sparsely, rather finely, subasperately punctate with scattered rugulæ.

Elytra fusiform-oval to oval. Base equal to the pronotal base, truncate to feebly bisinuate; humeri very small or absent; sides quite evenly arcuate, rather narrowly rounded at apex; disk moderately arcuate, more strongly rounded laterally, rather obliquely declivous apically; evenly and sparsely punctate, punctures equal in size, arranged serially in the central area, and closely placed in the series, interstitial punctures rather widely spaced, all becoming confused laterally and on the apex where they are minutely muricate, with the prickles discernible.

Parapleura finely and more thickly punctate. Abdomen sparsely punctate, punctures finely subasperate. Legs rather long and noticeably slender.

Male: Narrower and fusiform oval in form. Abdomen nearly on a plane with the sterna, very moderately convex and just noticeably flattened along the middle.

Female: Broader, elytra more oval. Abdomen a little more convex. Legs less slender.

Male, length 15.5 mm., width 8 mm.; female, length 14 mm., width 9 mm.

Type locality: Northfork, Fresno County, California. Collected by Mr. Henry Dietrich on March 4, 1920.

Holotype, female, and *allotype*, male in my collection; *paratypes* in Mr. Dietrich's and my own collection. A female paratype has been placed in the collection of the California Academy of Sciences by Mr. Dietrich. A series of twelve specimens have been studied.

The salient characteristics of *tularensis* are the absence of humeri and the unusually slender legs. The anterior femora have a small triangular tooth at about the outer fourth. *Confinis* Blais. is found in the foothills on the west slope of the Sierras and coast range foothills as well, and is a robust race with the pronotal sides without basal sinuations. *Perpunctata* Blais. is a larger and more elongate race, legs long and stout, sides of the pronotal disk noticeably impressed along the lateral margins; the latter character being entirely absent in *tularensis*. *Marinæ* Blais., a stouter more compact race found in Marin County, California, has the elytral punctuation distinct, the punctures diffuse and of equal strength throughout.

17. **Eleodes parvicollis alticola** Blaisdell, new variety

In form similar to *trita*, but less opaque and more finely punctured. Oblong-ovate, a little more than twice as long as wide. Head finely punctate, the punctures slightly denser at the periphery.

Pronotum about a fifth wider than long; finely and not very closely punctate, punctures slightly larger and somewhat granulate laterally in the marginal area, where the disk is very feebly impressed; apex, sides, base and angles as in *producta*. Propleura rather sparsely granulato-punctate, more or less rugulose on the coxal convexities.

Elytra less elongate than in *producta* and *planata*, about a third longer than wide; base truncate, wider than the pronotal base; sides moderately arcuate, apex obtusely and somewhat narrowly rounded; disk somewhat flattened, but moderately convex, less so in basal fourth, obliquely and arcuately declivous posteriorly; surface not eroded, moderately densely punctate, punctures slightly muricato-granulate, laterally and apically.

Prosternum rather densely punctate, elsewhere the punctures are more widely separated and not coarse. Abdomen densely and not very finely granulato-punctate on the first and second segments, less so on the third, fourth and fifth finely and sparsely punctate. Legs moderately stout. Sexual differences as in *trita*.

Length (types) 14-14.5 mm.; width 6.5-7 mm.

Types, male and female, in my collection.

Type locality: Piute Mountain, Kern County, California; collected May 29th, 1913. Many specimens have been identified.

Alticola is more shining and less coarsely punctate than *trita* Blais. although similar in form. *Planata* Esch. is more elongate and there is greater difference in body form between the sexes, besides it inhabits a different geographical region—the oak groves of the great valleys, while *trita* and *alticola* are found at higher altitudes in the mountains. *Constricta* Lec. is more strongly and coarsely punctate, with the elytra more depressed on the disk and the basal constriction of the pronotum is stronger and more abrupt, with the sides perfectly straight and parallel before the basal angles; in *alticola* the sinuations are more gradually formed and the sides not parallel.

18. **Eleodes manni dilaticollis** Blaisdell, new variety

Form oblong-oval, less than twice as long as wide, more robust and less elongate than *manni* Blais. Color deep black.

Head more transverse and the antennæ rather shorter than in *manni.* Pronotum distinctly more transverse than in the latter species and more strongly and a little more coarsely, closely punctate. Elytra more broadly oval, humeri more or less distinct, disk more noticeably muricately punctate laterally and about the apex. Otherwise as in *manni.*

Length (types) 13-15.5 mm.; width 5.6-7.6 mm.

Holotype, female, and *allotype,* male, and *paratypes* in my collection. Mr. M. C. Lane of Ritzville, Washington, also possesses paratypes and collected the types at Sprague, Washington, on May 15, and June 19, 1921; other specimens were secured at Lake McElroy, Paha, Washington, on May 24th. In the types the humeri are distinct. A considerable series has been studied and the differential characters have been found constant.

In *parvicollis* Esch. and its races the pronotal punctures are smaller and more distinctly separated. In *manni* var. *variolosa* Blais, the elytra are more coarsely and subrugosely sculptured, a character resembling that observed in *cordata* Esch.; the pronotum is less transverse and subequal in the sexes. In *dilaticollis* the pronotum is much more transverse in the female. In *horni* Blais. and its race *monticola* Blais. the sculpturing is finer, legs more slender and the surface luster more opaque. As a rule *manni* and its race *dilaticollis* have the pronotal sides less abruptly sinuate at base than is found in *parvicollis* and its races. These characters are maintained in larger series. *Sierra* Blais. is more alutaceous, elytra more parallel with the humeri more or less distinct.

19. **Eleodes nigrina difformis** Blaisdell, new subspecies

Form and size variable, more robust than typical *nigrina* Lec., mimicing *omissa* Lec.; the males less elongate. Color black, luster more or less moderately shining. Sculpturing as in *nigrina*. Comparative stoutness of appendages variable.

Male: Less elongate and broader, differing but little from the female in form.

Female: Broader on the average than the female of *nigrina;* pronotum quadrate to a fourth wider than long.

Length (types) 20-20.5 mm.; width 8-9 mm. Variations in size; largest female, length 23 mm., width 9.5 mm.; smallest female, length 15 mm., width 6 mm.

Holotype, female, and *allotype*, male, in my collection. *Paratypes* in the collection of Mr. M. C. Lane, Ritzville, Washington, and in my own. The types were collected at Lind, Washington, on April 10, 1920.

I am indebted to Mr. Lane for a generous series showing the remarkable variation in body form and size. Most of these specimens were taken in the vicinity of Ritzville, in September and October, 1921.

Large series of *nigrina* Lec. show an adherence to a uniform body form, and the individuals are more elongate and duller in luster, while the race *perlonga* Blais. is more elongate, polished and shining. *Schwarzi* Blais. has a differently formed

pronotum and is on the whole more robust as regards the dorso-ventral thickness of the body. *Nevadensis* Blais. is more slender, very dull and alutaceous in surface luster.

Neobaphion Blaisdell, new genus

This genus is proposed to receive *Eleodes planipennis* Lec. The genital characters are embaphionoid and the body form that of an *Eleodes*. It is therefore to be placed between *Eleodes* Esch. and *Embaphion* Say. in our lists. Since the Monograph on the Eleodiini (Bull. 63, U. S. Nat. Mus.) was written, at least three new species have been studied, unfortunately as uniques, but all referable to the genus as given above. For further data consult the above cited monograph.

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XVII

NEW HEMIPTERA FROM WESTERN NORTH AMERICA

BY

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The present paper contains the descriptions of 41 new species and subspecies of western Hemiptera. In great part these represent species that have accumulated through the field work of the curator of the department of entomology, in California and neighboring states. Their study has been incidental to the determination of the Hemiptera in the collection of the Academy, during the past five years, and are now published so the names can be used in work now in progress on our interesting western insect fauna.

1. **Vanduzeeina californica** Van Duzee, new species

Larger and less hairy than *balli* with a longer and more parallel head; testaceous brown, closely fuscopunctate, apex of scutellum with an oblong pale spot. Length 6-7 mm.

Head as wide between the eyes as long, but slightly narrowed apically, sides nearly rectilinear; cheeks shorter than tylus, their surface depressed next the prominent median portion of the tylus, their apex roundedly truncate; bucculæ high and subacutely angled as in *balli*. Sides of pronotum distinctly sinuate anteriorly, the anterior angles prominent; in *balli* nearly rectilinear or very feebly arcuated; transverse median impres-

sion feeble. Upper surface less convex transversely than in *balli*. Punctures on venter hardly as close as on dorsum, the median line smooth. Vestiture short, gray. Rostrum attaining apex of second ventral segment. Color soiled testaceous brown, closely fuscopunctate, the head, pronotum and connexivum more or less tinged with rufous; lower surface of head and sides of pectus nearly black; apex of scutellum with an oblong pale spot, rounded anteriorly and widened on hind margin, sparingly fuscopunctate and often outlined with fuscous; dorsum sometimes with a slender median white line more or less complete; pronotum usually with a pale point either side before the black annular callosities; expanded anterior angles pale; connexivum annulate at base of each segment. Antennæ fuscous, the incisures pale. Legs fuscous, the knees and tarsi pale.

Described from four male and three female specimens taken at Cisco, Calif., July, 1911, by Dr. Charles von Geldern and one taken by Dr. E. C. Van Dyke in Yosemite Valley Park, June 26, 1921.

The larger size, short sparse vestiture, sinuated pronotal margins, more parallel head and pale apical spot on scutellum will distinguish this species. As in allied scutellerids the male is more uniform in coloration with the pale markings more or less obsolete.

Type: Male, No. 1748, and *allotype*, female, No. 1749, Mus. Calif. Acad. Sci., collected in July, 1911, by Dr. Chas. von Geldern, at **Cisco, Calif.**

2. **Vanduzeeina borealis** Van Duzee, new species

Differs from *californica* in being larger, in having the cheeks more convex with their margins more acute and overhanging, and the disk of the pronotum more feebly, transversely impressed. The specimens at hand, two females, show a more distinct percurrent pale median carina above and the apical pale spot on the scutellum is scarcely indicated and is more triangular in form. Anterior pronotal angles more rounded, the humeral angles bounded by deeper depressions. Length 7.5-8 mm.

Described from two females, one taken by Mr. Wheeler at Emerald Lake, B. C., August 15, 1915, the other from Golden,

B. C. This should perhaps be considered as a subspecies of *californica* but it has the aspect of a distinct species.

Type: Female, No. 1750, Mus. Calif. Acad. Sci., collected August 15, 1915, at **Emerald Lake, B. C.** *Allotype* in author's collection.

3. **Margus repletus** Van Duzee, new species

Size and aspect of *obscurator* Fabr., but with legs and antennæ more robust, surface more strongly dotted with fuscous, tylus more rounded and less prominent and the spines of the antenniferous tubercles more acute. Length 8 mm.

Head a little longer than broad across the eyes; ocelli more distant than in *obscurator*, obviously nearer the eye than to the median line; tylus scarcely exceeding the cheeks, rounded, not compressed and prominent as in *obscurator*. Antennæ stout; segment I as long as head to hind margin of eye, one-fourth as wide as long, strongly narrowed on basal third; segments II and III subequal to I, IV a little shorter and thicker than III; tooth on antenniferous tubercle terete, exceeding the tubercle by width of segment II. Pronotum narrower than in *obscurator*, the expanded sides recurved, anterior angles broader and more obtuse; median line subcarinate behind the transverse depression; nervures of membrane stout, strongly anastomosing as in *inconspicuus;* whole upper surface strongly punctured, each puncture with a short golden hair. Rostrum attaining anterior line of intermediate coxæ. Male genital segment shorter, vertical, broadly sinuate at apex.

Color testaceous gray, tinged with yellowish on head and connexivum; maculated and strongly punctured with fuscous, including the legs and antennæ, the connexivum and tibiæ alternated with darker areas; beneath pale, dotted with rufous or fuscous, these punctures forming a row on hind edge of each ventral segment; vertex showing a pale median mark at base and two raised spots either side of base of tylus; tip of antennæ rufescent.

Described from one male taken in Palm Cañon, San Jacinto Mts., Calif., at 2000 feet elevation, June 12, 1909, by Mr. Fordyce Grinnell. In Stål's key this runs to *nigropunctatus* but differs in several particulars.

Type: Male, No. 1751, Mus. Calif. Acad. Sci., collected by Fordyce Grinnell June 12, 1909, in **Palm Cañon, San Jacinto Mts., California.**

4. **Cydamus abditus** Van Duzee, new species

Allied to *femoralis* and like that species with a long black-tipped spine at each humeral angle and at apex of scutellum; testaceous yellow, tergum, membrane, and apical segment of antennæ castaneous or black. Length 6-7 mm.

Head narrowed behind the eyes, as long there as half the width of the vertex between the eyes; cheeks not meeting over the tylus. Segment I of antennæ attaining apex of head; II and III subequal; IV a little shorter than II and III together, but little thinner than anterior femora, tapering to either end. Rostrum attaining hind coxæ; segment I much thickened, reaching posterior line of eyes; II twice longer than III and IV together; III one half of IV. Pronotum oblong, a fourth longer than wide, together with the head closely punctate; a broad transverse impunctate area covers the callosities; humeral spines erect, acute, as long as width across the ocelli. Scutellum narrow, smooth, with a marginal row of punctures; apical spine erect, as long as the humeral. Elytra coarsely punctate, reaching apex of third abdominal segment; clavus with three regular rows of punctures; corium with two strong veins, the areoles edged with a row of coarse punctures; membrane a mere margin to the oblique apex of the corium. Abdomen smooth and polished. Osteolar canal auriculate, prominent.

Color testaceous-yellow, paler beneath; membrane, broad vitta on tergum, genital segment and humeral and scutellar spines black; eyes and apical segment of antennæ castaneous, the latter paler at either end; antennæ and legs faintly punctate with dusky; tip of rostrum black.

Described from two male and five female examples taken by me from under stones at Nogales, Arizona, April 3, 1921. In structural characters this species is allied to *femoralis* but it is very distinct otherwise.

Type: Male, No. 1752, and *allotype*, female, No. 1753, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 3, 1921, at **Nogales, Arizona.**

5. **Lygidea essigi** Van Duzee, new species

Closely related to *obscura* Reuter, a little broader, darker colored, head fuller and antennæ thicker. Length 6 mm.

Male: Vertex strongly convex, highly polished, basal carina slender, with a deep depression before it, median line very feebly impressed; clypeus less prominent than in *obscura*, its basal incisure shallow; eyes

smaller than in *obscura*. Antennæ stouter; segment I a fifth longer than width of vertex; II nearly three times as long as I and distinctly more slender; III and IV together more than half of II, IV a third of III. Rostrum reaching on to base of hind coxæ. Pronotum broader before than in *obscura*, the rounded anterior angles attaining outer third of eyes; transversely depressed behind the prominent polished callosities; sides slightly concave, hind margin distinctly emarginate; surface behind the transverse impressed line closely deeply punctate; elytra distinctly widened to near apex of corium, parallel in *obscura*. Sinistral clasper much as in *obscura*, stouter, dorsal member longer and more curved, ventral member meeting the dextral clasper in an almost straight line, not at an angle as in the related species.

Color black; cheeks, except at base, a very obscure median line on vertex, a broader one on posterior lobe of pronotum, collum and cuneus, except at apex, pale yellowish; vestiture pale, rather conspicuous on scutellum and elytra; membrane deep smoky and a pale annulus at apex of areole; legs and beneath pale yellow with a broad black vitta either side, covering most of the genital segment; apex of femora and tips of tibiæ fuscous, the tarsi mostly black; antennæ black; rostrum mostly pale. Described from the unique type.

It is impossible to identify this with *Lygidea morio* Reut., a species still unknown to me in nature.

Type: Male, No. 1754, Mus. Calif. Acad. Sci., collected by Prof. E. O. Essig, May 19, 1922, at **Los Altos, Santa Clara Co., California.**

6. **Camptobrochis slevini** Van Duzee, new species

Size and aspect of *rufiventris* Knight but belonging to his group II having the scutellum punctate and the arolia without a deep cleft. Apparently allied to *atriventris* Knight but differing in many respects; deep black, cuneus red, head and scutellum opaque, rugose-punctate. Length 5 mm.

Male: Head one-half as wide as base of pronotum; closely rastrate-punctate and opaque, with sparse white hairs. Segment I of antennæ much exceeding the head, II stout, two and a half times as long as I; III and IV wanting in type. Pronotum with coarse shallow punctures; hind margin broadly emarginate, the humeri scarcely retreating; sides ecarinate. Scutellum flattish, opaque, closely rugose-punctate including the basal lobe. Elytra closely, finely punctate, the embolium confined to basal third and scarcely reflexed; cuneus closely rugose-subpunctate.

Rostrum attaining apex of hind coxæ; mesosternum and pleuræ in part opaque. Sinistral notch of male genital segment rounded, the sinistral clasper broad, flattened and rugose, its apex becoming terete and curved under around apex of segment.

Color black, moderately polished; the head, collum and scutellum opaque or scarcely shining; base of vertex, tip of scutellum, middle of tibiæ and most of tarsi testaceous; thickened inner margin of corium beyond tip of clavus and the cuneus red, the latter with basal and apical angles blackish; margin of acetabulæ and osteolar region whitish. Described from the unique type.

In size, form and coloring this species recalls *Pœciloscytus venaticus.* It is somewhat aberrant in this genus but does not better fit into any other.

Type: Male, No. 1755, Mus. Calif. Acad. Sci., collected by Mr. L. S. Slevin, September 18, 1920, at **Carmel, California.** It affords me pleasure to dedicate this species to its discoverer.

7. **Strongylocoris uniformis** Van Duzee, new species

Allied to *robustus* Uhler, but with the legs and antennæ entirely black and with different male genitalia. Length 4 mm.

Vertex convex and highly polished; clypeus a little shorter than in *robustus;* antennæ a little shorter and more robust. Dextral male clasper forming a semicircle vertically but without lateral curvature, within widened in a bluntly rounded lobe at basal third, and at distal third armed with a very acute tooth, the long slender apical member acute, becoming castaneous at tip. Sinistral clasper small, slender, its acute apex sharply incurved over the ædeagus.

Color deep polished black, apical half of the antennæ becoming fuscous, membrane deep fuliginous toward its apex with a paler mark at apex of cuneus. Antennæ and sides of pronotum and elytra with a few brown hairs.

Described from two males and eleven females taken on sage brush at Heber, Utah, July 5, 1922. The almost uniform black color and long, acutely produced dextral male clasper will distinguish this species.

Type: Male, No. 1756, and *allotype,* female, No. 1757, taken by E. P. Van Duzee, July 5, 1922, at **Heber, Utah.**

8. **Largidea pudica** Van Duzee, new species

A little larger than *marginata;* polished luteous-brown, slightly tinged with red, the cuneus red; vertex, mark on pronotum and the antennæ blackish. Length 4.5 mm.

Male: Head larger with the eyes more prominent than in *marginata*. Antennæ about as in *marginata;* segment I a little longer than the vertex when viewed from above; II as long as head and pronotum together; III and IV slender, together nearly one-half of II. Pronotum a half wider than long, more convex above than in *marginata*, the sides less strongly carinate and nearly rectilinear; hind edge more broadly excavated; surface less closely punctured. Scutellum broader and more convex with the sides steep, the depressed tip acute; punctures subobsolete. Elytral punctures larger, more distant and becoming subobsolete. Rostrum scarcely surpassing middle of mesosternum. Surface sparsely clothed with cinerous appressed hairs which become denser on callosities and vertex.

Color a lurid luteous-brown; apex of tylus and cheeks, a narrow median cloud or two crescentic vittæ on face, region of callosities and basal lobe of scutellum black; antennæ reddish fuscous, the base of segment I clearer red; hind edge of pronotum pallid; cuneus red; membrane faintly smoky, the veins fuscous; legs and abdomen in part reddish, the tarsi, rostrum and mesosternum blackish.

Described from two males, one taken by me at Colestin, Oregon, the other taken by Mr. W. M. Giffard at Tallac, California, August 22, 1916. The polished surface and luteous-brown color gives this species quite a different aspect from *marginata*.

Type: Male, No. 1758, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, August 1, 1918, at **Colestin, Oregon.** *Paratype* in collection of the author.

9. **Orthotylus plucheæ** Van Duzee, new species

Allied to *hamatus,* smaller with different male genitalia, base of tylus with a dark spot; pale greenish, tinged with yellow, membrane faintly smoky, segment I of antennæ dusky in male. Length 4.5-5 mm.

General characters essentially those of *hamatus,* the pronotum more convex and more narrowed before, with its sides distinctly concavely arcuated. Sinistral male clasper terete, reaching but about half way to

apex of genital segment, exceeded by the brown chitinized spine-like ventral member. Dextral clasper ligulate, curved over and considerably passing the middle of the segment, its truncate apex with a minute sharp ventral tooth, its dorsal edge notched at basal third and armed there with a short parallel tooth. In *hamatus* the sinistral clasper is much larger and more slender and pointed, and the dorsal notch of the dextral clasper is larger with a longer tooth. Rostrum attaining hind edge of mesosternum.

Color pale yellowish green, minutely white-pubescent; antennæ of male dusky with the inner face of segment I pale; membrane faintly but obviously smoky, with pale veins; tip of tarsi and of the rostrum black.

Described from 6 males and 3 females taken on *Pluchea sericea* at Potholes, Imperial Co., California, April 13, 1923. This is very close to *hamatus* but the smaller size and much less developed male genitalia would seem to indicate specific distinction.

Type: Male, No. 1759, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 13, 1923, at **Potholes, California.**

10. **Orthotylus demensus** Van Duzee, new species

Size and aspect of *languidus* but with thicker antennæ, shorter pubescence and different male genitalia. Length 5 mm.

Male: Head as long as in *languidus*. Antennæ thicker; segment I scarcely as long as distance between the eyes; II three times as long as I and nearly as stout; III and IV wanting on material before me. Pronotum 2½ times as wide as long, sides rectilinear or scarcely concave (in *languidus* fully half as long as wide, with sides concave). Elytra parallel. Rostrum not attaining intermediate coxæ. Sinistral clasper transversely developed, dorsal member attaining upper plane of segment, broad, subparallel, rounded at apex; ventral member narrow, acute, produced backward making the apical line of the clasper oblique and nearly rectilinear. Dextral clasper nearly square, the dorsal basal angle rounded, the dorsal apical acutely incurved. Vestiture soft and white but shorter than in *languidus*.

Color pale yellowish green or almost whitish, the fuscous mesonotum showing through the pronotum; basal lobe of scutellum tinged with fulvous; elytra more greenish, the veins clear pea-green, areoles sprinkled with green dots at base of the hairs; membrane very slightly enfumed and iridescent; antennæ and legs yellowish, tips of tarsi black.

Type: Male, No. 1760, Mus. Calif. Acad. Sci., collected by C. A. Hill, July 8, 1917, at **Prescott, Arizona.** *Paratypes,* two males, same data.

11. **Orthotylus cupressi** Van Duzee, new species

Dusky green with fulvous scutellum; surface clothed with rather long black hairs; outer half of membrane deeply infuscated, cut by a white spot at apex of areole. Length 5 mm.

Male: Head broad, convex above, somewhat obscuring the basal carina; clypeus but moderately prominent. Rostrum attaining apex of hind coxæ. Pronotum short, twice wider than long, regularly arcuate before. Scutellum, large, rather convex. Elytra nearly parallel, the costa but feebly arcuated. Sinistral clasper developed transversely in an open crescent, its dorsal member about twice longer than its basal thickness, acute at apex; ventral member broadly obliquely truncate at apex, its upper angle forming a short curved hook, its lower curved and very acute, nearly attaining the base of the dextral clasper; the latter, also, subcrescentic, its ventral member ligulate with its twisted truncated apex at median line of the segment, its dorsal member forming a short erect acute tooth.

Color a dull, almost an olive, green, paler toward the costa, the tylus and front of pronotum tinged with yellow; cuneus paler with a whitish cloud at base; membrane infuscated, its outer half, including the areoles, darker with a pale mark at apex of the areole; tergum black; beneath paler, the mesosternum tinged with fulvous-brown; legs and antennæ yellowish green, clothed with short black hairs; apical two segments of antennæ infuscated, the tarsi becoming black at apex.

Described from one male and three female examples taken by me on Sargeant's Cypress growing on "Cypress Ridge" at Fairfax, Marin Co., Calif., April 30, 1922, and May 11, 1919. This species is very distinct from any heretofore described. Its dark green color, fulvous scutellum, heavy black vestiture and infuscated membrane will distinguish it, while the male claspers are unlike those of any other species known to me. It has slightly the aspect of an Ilnocora but does not pertain to that genus.

Type: Male, No. 1761, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 30, 1922, at **Fairfax, California.**

12. **Orthotylus contrastus** Van Duzee, new species

Form and aspect somewhat of *Teratocoris discolor* Uhler. Large, elongate-ovate; black; legs, median line on pronotum, and elytra whitish, the latter with a large fuscous mark on apex of corium. Length 6 mm.

Female: Head short, polished; clypeus unusually prominent; antennæ long; segment I as long as head viewed from side; II four times as long as I; III not quite one half of II; IV missing in type. Pronotum campanulate; sides strongly concave, the constriction farther back than in *affinis;* callosities convex, polished; posterior lobe and scutellum minutely, transversely rastrate-shagreened. Elytra widened to apex of corium.

Color dull black; head and callosities polished; apex of cheeks and collum ferruginous; orbits of eyes above, median vitta on posterior lobe of pronotum and elytra obscure whitish; base of clavus and an irregular spot on apex of corium black, the latter mark extended anteriorly next the costal nervure and on discal areole, outer margin of clavus dusky; cuneus with a blackish mark on inner edge near apex; membrane smoky; paler along middle and at apex of cuneus, the pale nervures margined with darker; rostrum, except apex, legs and disk of venter pale; extreme base and apex of tibiæ and the tarsi dusky. Described from the unique type.

This large black and white species is so distinct from any other described form it seems safe to found the species upon a unique female.

Type: Female, No. 1762, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 8, 1922, on **Mt. Timpanogos, Utah, at** an elevation of nearly 8,000 feet.

13. **Parthenicus brunneus** Van Duzee, new species

A slender testaceous-brown species, obscurely irrorate with sanguineous; membrane deeply infuscated, with paler areoles. Length 4 mm.

Male: Vertex rather flat; clypeus small but prominent and much compressed; segment I of antennæ a little longer than basal width of vertex; II five times the length of I; III and IV together equal to II. Pronotum scarcely twice wider than long. Elytra narrow, parallel, the costa scarcely arcuated. Legs long for the genus, the hind femora proportionately narrower; hind tibiæ nearly as long as the corium. Male claspers small and obscure.

Color light testaceous-brown, sparsely irrorate with irregular sanguineous blotches, these becoming fuscous dots on the pronotum; head and anterior area of pronotum yellowish, obscurely irrorate with red; region of callosities more or less infuscated; membrane quite deeply infuscated, veins dotted with red, the areoles and adjacent spots at apex of cuneus paler; vestiture consisting of black scale-like hairs and longer pale hairs along costa, on sides of pronotum and on vertex; antennæ paler toward base; segment I with a brown dot near base beneath; pectoral pieces and coxæ without irrorations; venter irrorate with red; femora irrorate with brown, the posterior more closely so; tibiæ with large brown dots; tarsal claws black.

Described from two male and three female examples taken on Baccharis. The large eyes, elongate narrower form and long hind legs would ally this species with Argyrocoris but it is certainly a Parthenicus. The larger size, darker color, black scale-like vestiture, dotted hind femora and red dotting on elytra and veins of membrane will distinguish this species from *baccharidis* Knight.

Type: Male, No. 1763, and *allotype*, female, No. 1764, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, September 9, 1917, at **Berkeley, California.** *Paratypes,* same data.

14. **Parthenicus sabulosus** Van Duzee, new species

Related to *soror* but allied to *candidus* by the spotted membrane; soiled white irrorate with croceous or brown; membrane coarsely, conspicuously dotted. Length 3.5 mm.

Male: Head broader than in *soror* with smaller eyes; pronotum broader anteriorly; elytral costa feebly arcuated. Rostrum reaching well on to the base of the venter. Claspers larger than in *soror,* the dextral forming more than a half circle, its apex elbowed at the median line of the genital segment with its incurved tip slender and very acute.

Color whitish tinged with yellow on the head; pronotum and elytra sparsely and sometimes obscurely dotted with croceous or pale sanguineous, these dots becoming brownish at times; region of callosities and base of scutellum more or less infuscated; membrane white, coarsely and sparsely dotted with fuscous, with two marginal clouds beyond apex of cuneus; beneath sparsely dotted with sanguineous with a lateral fuscous vitta on venter; antennæ slightly darker at apex; segment I with a faint subapical annulus; femora minutely dotted with fuscous beyond the middle, the posterior more heavily so, forming a fuscous cloud there

which omits the tip; vestiture silvery, becoming golden along claval suture, on cuneus and about callosities; a tuft of black scales at apex of clavus and two more on apical margin of cuneus.

Described from two males and 11 females taken on Artemesia. This species, with *aridus* Knight and *canescens* Van D., have coarsely dotted white membranes.

Type: Male, No. 1765, and *allotype*, female, No. 1766, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 1, 1922, at **Salt Lake City, Utah.** *Paratypes*, same data.

15. **Parthenicus pallidicollis** Van Duzee, new species

Closely allied to *picicollis* Van D. but paler in color with the pronotum mostly whitish; largely sanguineous with the hind femora and scutellum darker and the pronotum pale. Length 4.5 mm.

Male: Vertex broader and fuller with the eyes smaller than in *picicollis;* segment II of antennæ slightly longer than basal width of pronotum, the latter obviously longer with the sides less oblique than in *picicollis.* Elytral costa distinctly arcuated, in *picicollis* essentially straight. Claspers about as in *picicollis*, the subapical ventral tooth of the dextral less prominent.

Color above soiled creamy white, the elytra more or less washed or blotched and irrorate with sanguineous, more conspicuously so on base of corium and on the cuneus, inner angle of corium with a pale fuscous cloud more or less distinct; clypeus, cheeks and arcs of front more or less sanguineous; antennæ pale, segment I tinged with red; pronotum pale or lurid, more or less irrorate with red about the borders, becoming piceous-red on sides inferiorly and sometimes across the callosities; scutellum dark piceous-red; membrane deeply infuscated as in *picicollis* but with a distinct pale lunule at apex of cuneus which is only indicated in its ally, veins red, usually with a white mark at apex of larger areole; beneath and hind femora piceous-red, more or less irrorate with pale; tibiæ pale with rather large red dots; antennæ pale, segment I red, pale at apex, III and IV slightly infuscated; coxæ and rostrum infuscated; vestiture of short golden scales and longer pale hairs on head, sides of pronotum and base of costa. Described from 30 examples representing both sexes.

This species may be distinguished from *rubromaculosus* Knight (1925) by the larger size, deep red scutellum sides of

pronotum and hind femora, and the pale fuscous color on inner field of corium.

Type: Male, No. 1767, and *allotype*, female, No. 1768, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 23, 1918, at **McCloud, Siskiyou Co., California.** *Paratypes*, same data.

16. **Parthenicus discalis** Van Duzee, new species

Near *covilleæ* Van D., and running to that species in my key of 1918; antennæ longer, lower surface and femora sanguineous. Length 3.75 mm.

Head about as in *picicollis*, distinctly more produced than in *covilleæ*, its length beyond the eye about equal to the length of the eye; antennæ distinctly longer than in *covilleæ*, as long as the elytra to tip of cuneus; segment II five times the length of I.

Color pale croceous; apex of head, segment I of antennæ, its extreme tip excepted, deflexed sides of pronotum, scutellum and femora except at base, dark sanguineous; base of elytra, a cloud on inner angle of corium touching apex of clavus and extended down the commissure to base of membrane, cuneus and beneath, lighter sanguineous or slightly irrorate with pale; sternum, coxæ and rostrum pale; tibiæ and tarsi pale, the former with a few sanguineous dots; claws black; membrace deep fuscous with an obvious pale lunule at apex of cuneus, the veins sanguineous; antennæ, except segment I, whitish scarcely dotted with red; IV somewhat infuscated; pale surface above showing no red irrorations.

Described from three females. These specimens are without a hairy vestiture.

Type: Female, No. 1769, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, October 18, 1917, on **Mt. Wilson, California.** *Paratypes*, same data.

17. **Parthenicus grex** Van Duzee, new species

Allied to *psalloides* and *juniperi*, larger, testaceous-yellow, the elytral pigment coagulated in spots and varied with small sanguineous blotches; membrane slightly enfumed, with a darker spot beyond the cuneus. Length 4.5 mm.

Macropterous male: Head broadly convex across vertex, the impression at base of clypeus not as deep as in the allied species; clypeus com-

pressed and subacute at tip. Antennæ long; segment I surpassing clypeus by a third its length, linear; II three times I; III and IV together equal to II. Rostrum reaching to middle of venter. Pronotum but slightly convex, trapezoidal, sides straight, anterior margin one half the posterior. Elytral costa gently arcuated; surface clothed with short golden pubescence intermixed with a few black hairs across apex of corium, on inner margin of cuneus and at apex of clavus; costa and pronotal margins with longer golden hairs; vertex and pronotum anteriorly with a few silvery scale-like hairs. Claspers large; sinistral subterete, curved about the margin of the segment, abruptly slender, acuminate and incurved beyond the middle; dextral slender, curved, abruptly oblique and acuminate at tip; both fringed above with long pale straight hairs.

Color testaceous-yellow, more or less tinged with croceous, especially on head and hind femora, the color on the elytra apparently coagulated; the elytra dotted with irregular sanguineous blotches and points which may be mostly absent, but are more persistent along costa; membrane faintly enfumed with a darker cloud beyond tip of cuneus and a fainter one at apex; veins yellowish with a few sanguineous points; antennæ pale, subinfuscated at apex; beneath paler; tip of rostrum and tarsal claws black; hind tibiæ with obscure sanguineous points, eyes red.

Described from three males and four females. Three of the latter are brachypterous, being broad-oval, with membrane scarcely exceeding apex of cuneus.

Type: Male, No. 1770, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 21, 1919, at **Stockton, California.** *Paratypes,* same data.

18. **Cixius vandykei** Van Duzee, new species

Allied to *basalis,* distinguished by its broader and more setose elytra, narrower vertex and different male genitalia. Length 5-6 mm.

Head more produced than in *basalis;* vertex nearly as long on its median line as wide at base, (in *basalis* scarcely one half as long as wide), at apex subacutely angled; apical compartments narrower, their outer angles more produced posteriorly; base of vertex more deeply elliptically excavated. Pronotum narrower and more produced before, its hind margin more deeply, acutely excavated; lateral carinæ of mesonotum more distant and outwardly arcuate than in *basalis.* Elytra shorter and broader, with the costa strongly and almost regularly arcuate; inner sector (radial vein) forked a little farther from base than in *basalis,* all veins heavily dotted, with longer black setæ. Front more narrowed at base, with the sides

straight nearly to apical angles. Expanded apex of male plates longer and more rounded; anal teeth of pygofer short, more divergent, not long and parallel as in *basalis*.

Color paler, testaceous-yellow, clouded with piceous-brown or fulvous-brown on head and thorax; front and clypeus quite uniformly brownish, the carinæ paler, the lateral with small pale spots at apex of front; elytra hyaline, feebly milky white, veins strongly dotted with fuscous and more or less marked with the same color in the female, mostly in the form of a large discal spot, sometimes forming a longitudinal cloud on clavus which may cover more or less of the corium; beneath and legs pale, the femora with a faint brown subapical cloud.

Described from two males and four females taken as follows: Lagunitas Cañon, April 23, 1916 (E. C. Van Dyke); Lagunitas, July 4, 1909 (Van Dyke); Muir Woods, July 19, 1914, and Ross, July 7, 1921 (E. P. Van Duzee); Mt. Tamalpais, June 23, 1918 (E. P. Van Duzee), all in Marin Co., Calif.; Berkeley, Calif., July 30, 1922 (J. O. Martin).

Type: Male, No. 1771, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 7, 1921, at **Ross, California**; *allotype*, female, No. 1772, Mus. Calif. Acad. Sci., collected by E. C. Van Dyke, July 4, 1909, at Lagunitas, Calif.

19. **Cixius præcox** Van Duzee, new species

Very near *cultus* Ball but with the elytral nervures infuscated, the radial and outer branch of ulnar veins forked on the same line (in *cultus* the radial forks a little basad of the outer ulnar); lateral pronotal carinæ bent abruptly where they touch the hind margin (in *cultus* forming a more rounded angle); male plates more arched, uniting in an almost circular arc (in *cultus* angularly connivent); apical member a little broader and more oblique; sides of ventral sinus of pygofers more oblique, with the basal tooth larger than in *cultus;* front proportionately longer than in *cultus.* Length 5 mm.

Color essentially as in *cultus;* elytra more whitish opaque, the cross nervures and apices of all veins marked with fuscous; costa and commissure typically alternated with obscure fuscous; stigma fuscous, white at base. Veins undotted.

Type: Male, No. 1773, and *allotype*, female, No. 1774, Mus. Calif. Acad. Sci., collected by G. F. Moznette, March 14, 1915,

at **Corvallis, Oregon.** *Paratypes,* one female, same data; one female, Shasta Co., Calif., July 17, 1921 (J. A. Kusche), and one male and two females taken by Mr. W. Downes at Vernon, B. C., Sept. 27, 1919, and Enderby, B. C., Oct. 10, 1920.

20. **Œcleus subreflexus** Van Duzee, new species

Apparently allied to *addendus* Dist., aspect of *fulvidorsum* but with the elytral nervures nearly impunctate and the costa slightly expanded at base. Length 5 mm.

Vertex about as in *fulvidorsum* but more narrowed to the base, but little exceeding the eyes; front broad below, regularly narrowing to the base, more abruptly to the apex where it is about twice wider than at base; carinæ prominent, the median nearly obsolete at base. Pronotum short, angularly excavated behind; mesonotum with five distinct carinæ. Elytra wider than in the allied species with a broader costal areole, the margin at base narrowly explanate exterior to the costal vein. Genital segment of male shallowly notched with a slender, almost linear, median tooth, which slightly exceeds the sides of the segment; stiles much as in *fulvidorsum* but quite strongly connivent at apex.

Color creamy white; claspers fuscous or nearly so; middle line of vertex blackish; mesonotum fulvous varied with brown; elytra obscurely fusco-hyaline; nervures white with scattering black setæ, in the male those toward the apex springing from brown points; abdomen more or less overspread with black.

Described from seven male and four female examples taken on *Pluchea sericea* at Potholes, Imperial County, California, April 7-13, 1923. Allied to *fulvidorsum* by the characters of the vertex, front, mesonotum and male genitalia; separable by the almost undotted elytral nervures and the narrowly expanded costa. *Œcleus snowi* Ball is a much larger and broader species of a more fulvous color and broader costal expansion. Of this latter species I took one pair in copula at Potholes, Calif., resting on a poplar bush. A few specimens of *subreflexus* taken April 8 were found on Atriplex.

Type: Male, No. 1775, and *allotype,* female, No. 1776, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 13, 1923, at **Potholes, Calif.**

21. **Pissonotus giffardi** Van Duzee, new species

Very close to *delicatus* but distinguishable by the distinctly longer legs and different male genitalia. Length, brachypterous form, male, 2.5 mm., female, 3.5 mm.

Male: Vertex scarcely longer than broad, feebly arcuate before; lateral carinæ sharp, well elevated; median obscure; apical fovæ obvious. Front twice longer than broad, sides very feebly arcuate, almost parallel; carinæ prominent, the median obscurely forked a little above the lower angle of the eyes. Carinæ of clypeus prominent, the median obsolete near base. Antennæ long, surpassing tip of clypeus, clothed with minute black hairs; basal segment as long as width of front; second about one third longer. Pronotum nearly as long as vertex, truncate behind; carinæ prominent, the lateral attaining hind margin, the fovæ deep, about a third wider at base than at apex. In *delicatus* the lateral carinæ are more oblique and do not quite reach the hind margin of pronotum. Mesonotum a little longer than pronotum; median carina prominent, lateral distinct but slender. Elytra on commissure as long as pro- and mesonotum together, attaining apex of second tergal segment; subcoriaceous, polished; venation obscure. Legs very long, the hind tibiæ as long as vertex, pro- and mesonotum and elytra combined, or even a little longer to tip of the shorter apical spines; first segment of hind tarsi as long as width of head across the eyes.

Aperture of male pygofers broad ovate, the sides forming an obtuse lobe either side ventrally; the anal hooks long, following the margin of the pygofers, their black apex slender, curved outward and lying on the thickened base of the ventral opening; the ventral spines slender, black, lying near to and parallel with the apex of the anal hook; stiles short and broad, their length equal to their combined width, their broad rounded apices incurved and subcontiguous. *Marginatus* has the anal hooks equally long but their apices are thicker, pale and parallel, the ventral spines are represented by pale tubercles and the stiles are broad, flat, moderately divergent and truncate at apex.

Color honey-yellow, paler on pronotum, across the apex of the front and on the breast and legs; elytra strongly tinged with castaneous; their apex white, usually marked at middle with a blackish spot in the males; abdomen pale rufo-piceous in the male, the genital area whitish with a piceous cloud covering the stiles; legs lineate with brown, the base with a spot exteriorly and the apex of the tarsi blackish; the usual black band covers the base of the fore coxæ and clypeus and extends on to the pleural pieces.

Described from 10 male and 20 female examples taken on tar weed near Grossmont, 17 miles east of San Diego, California, June 2, 1919, by Mr. W. M. Giffard. It gives me

September 24, 1925

pleasure to dedicate this species to Mr. Giffard who has done more than anyone else to elucidate the delphacid fauna of California.

Type: Male, No. 1777, and *allotype*, female, No. 1778, Mus. Calif. Acad. Sci., collected by W. M. Giffard, June 2, 1919, at **Grossmont, California.**

22. **Cyrtolobus pictus** Van Duzee, new species

Near *inermis* Emmons, agreeing with that species in the form of the dorsal crest, in the unicolorous pale green female and the strongly maculated male; differing in the shorter pronotum and in the markings of the male. Length 4-5 mm.

Allied to *vau* but smaller, dorsal crest lower with the anterior sinus scarcely indicated in the male; in the female with the crest more uniformly arcuate with an anterior sinus; apex of pronotum even shorter than in *vau*, not attaining tip of fourth apical vein; face not as flat as in *vau;* smooth, polished, uneven, obscurely punctured toward apex of cheeks, incisures of clypeus deep, its apex rounded. Elytra hyaline, in male with veins heavy and fuscous, the apex with a small smoky cloud, about half of which lies on the apex of the areoles. Female without such cloud, the veins pale, concolorous; surface sparsely clothed with short erect hairs.

Color a uniform pale green in female; male a clear greenish yellow on face pronotum, legs and margins of pleural pieces; face with a median vitta, a cloud either side and the clypeal sutures black; pronotum with a mark above each eye, the apex and a broad triangular vitta behind the middle, black, including a dorsal yellow mark; anterior to this vitta is a broad vague oblique maculate area either side meeting above the humeri. These markings on the male leave the anterior portion of the pronotum, a rather wide, oblique, median vitta, a dorsal spot more or less completely connecting with this vitta, and a wide transverse subapical band, yellow. In *vau* this dark color is more extended with the included pale dorsal spot larger. Edges of abdominal segments and genital pieces mostly yellow. Femora black in the male, with their apices broadly yellow, the tibiæ minutely dotted.

Described from 8 male and 12 female examples beaten from oaks growing along the cañon of the south fork of the Provo River at Vivian Park, Utah. This species is really nearest to *inermis* Say and like that species might almost as properly be placed in subgenus Atymna. The male may be distinguished

by the different and more extended yellow markings of the pronotum. In *acutus,* which was taken in company with this species, the female shows more maculation on the pronotum and the pale markings of the male are narrower and do not include the front of the pronotum. It is also larger and has the pronotum more pointed at apex. The females of *pictus* differs but little from those of *inermis* and the female specimen from Ogden, Utah, recorded by me in my Studies on the Membracidæ (Bul. Buf. Soc. Nat. Sci., ix, p. 90, 1908) belongs here.

Type: Male, No. 1779, and *allotype,* female, No. 1780, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 7, 1922, at **Vivian Park, Provo Cañon, Utah.**

23. **Mesamia pagana** Van Duzee, new species

Near *nervosa* Osb. but with the submarginal black line on vertex with three interruptions and the costal area without supernumerary transverse veins. Length 4.25 mm.

Male: Head almost as wide as prontum; vertex flat, anterior margin in a rounded arc, one-fourth longer at middle than at eye, edge acute and slightly reflexed. Pronotum nearly twice as long as vertex. Elytra not flaring at apex; about six transverse veinlets between inner sector and claval suture; costal area without supernumerary veins; clypeus strongly widened at apex. Valve short, broadly arcuated; plates long-triangular, acute and slender at apex, edge long-ciliate.

Color obscure greenish yellow varied with darker; vertex whitish on anterior and posterior margins; anterior submargin with a heavy black line interrupted at middle and on either side; behind this is a dusky line which touches the other at either end. Face dusky yellow; front pale brown with paler arcs and a heavier black basal line; cheeks with a longitudinal dusky line below the eyes; pronotum dusky greenish, yellowish anteriorly; scutellum yellow either side, the impressed line black; elytra greenish yellow, veins conspicuous, fuscous; apex of claval areoles and narrow margin of membrane dusky, the claval suture with three large, vague, pale spots; legs pale, posterior with tibial dots and apex of tibiæ and tarsi black; abdomen black, marked with yellow, these markings forming a slender line on the hind margin of each segment; a large testaceous spot either side on venter, the connexivum mostly yellow; plates pale with a spot at base and sutural lines near apex fuscous.

Described from the unique type. Apparently allied to *nervosa* Osb. (Fla. Ent. VI, p. 20, 1922) but the want of costal transverse veins and the coloration will most quickly distinguish it.

Type: Male, No. 1781, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 24, 1922, at **Kings Station, Davis Co., Utah.**

24. **Mesamia diana** Van Duzee, new species

Larger than *coloradensis* with a flatter and more angled vertex; elytra strongly veined. Length 4.5 mm.

Head scarcely narrower than pronotum; vertex flat, anterior edge sharp, somewhat reflexed, strongly angled; front a little broader than in *coloradensis,* sides more arcuated below; clypeus slightly widened to tip Pronotum a fourth longer than vertex; elytra moderately flaring; inner sector connected with claval suture by numerous transverse veinlets; costal areole with six to eight oblique veinlets, heavily marked with fuscous.

Male valve short, subacute, angulate; plates long-triangular, their acute tips surpassing the pygofers; last ventral segment of female angularly excavated nearly to the middle, with a square, feebly bifid, median tooth; pygofers broad spindle-shaped, nearly equalling the oviduct.

Color cinereous tinged with yellow on vertex, anterior margin of pronotum and scutellum, more marked in male; subapical line on vertex interrupted at middle where there is a triangular extension backwards either side of the median pale line; behind this a transverse dusky cloud connecting the ocelli and obscuring the disk of the vertex; median incised line black at base. Face pale, more or less clouded with brown, especially on base of front where a few pale arcs are discernible, extreme base with a concentric black line. Pronotum irrorate with brown and pale; scutellum dusky at basal angles, the incised line dark. Elytra milky-cinereous, the veins strong, fuscous, disk of areoles mostly with fuscous cloud. Legs and beneath whitish, the pleuræ marked with black; tibial dots and apex of tibiæ and tarsal joints black; venter pale yellow, hind margin of segments blackish.

Described from one female and three males taken by me in San Diego County, California, as follows: Mussey's, August 7, 1913 and April 12, 1914; Lakeside, May 7, 1913; Alpine, June 8, 1913. This species has the broad form of *Aligia in-*

scripta but the flatter vertex with hooked submarginal line, and the strongly veined unclouded elytra will distinguish it.

Type: Female, No. 1782, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 7, 1913, at **Mussey's, San Diego Co., California.** *Allotype* and *paratypes* in collection of the author.

25. **Aligia californica** Van Duzee, new species

Related to *inscripta* with a similarly angulated vertex; longer and more slender, quite uniformly inscribed with fuscous. Length 5 mm.

Female: Head distinctly wider than pronotum; vertex flat, quite strongly angled before, typically two-thirds as long as pronotum but varying to one half its length; front scarcely longer than wide, sides nearly rectilinear below antennæ; clypeus slightly widened at apex. Hind margin of pronotum subangularly emarginate. Elytra four times as long as wide, with numerous transverse false veins, especially in costal, subapical and sutural areoles of corium. Last ventral segment produced on its median fourth with a linear central notch.

Color pale testaceous, tinged with fulvous on vertex and scutellum; vertex with a pair of small spots behind apex, another pair either side near base; sometimes a point within the ocelli and a broken transverse band just behind the ocelli brown, the broad incised line black; front with obscure arcs, outer angles of loræ with black points; pronotum mottled with brown, anteriorly pale with three large spots either side; scutellum with two discal dots, a small lateral spot either side and a transverse band before the apex brown, the curved incised line black; elytra whitish, venation brown, becoming fuscous on costa and apex; commissural vein and tips of claval veins white, with a fuscous spot anterior to each white vein and one at apex indicated; disk of a few of the areoles with vermiculate inscriptions; beneath pale, slightly varied with brown; anterior and intermediate femora bilineate; tibiæ with strong black dots; pale spines of pygofers set in black points, sides of oviduct black.

Male: Proportionately shorter than the female; valve short, broadly angled; plates acutely triangular, but little shorter than wide at base, sides straight.

Described from 8 females, 7 of which were beaten from chaparral and juniper bushes at Mill Creek Cañon, San Bernardino Mountains. The other I took at Pine Hills, Cuyamaca Mountains, California, October 19, 1913. Three individuals

have the vertex distinctly shorter but I fail to detect any specific differences. Also two males: Colestin, Jackson Co., Oregon, August 1, 1918, and Mt. Tamalpais, Marin Co., California, June 23, 1918.

Of *Aligia inscripta,* in addition to the type, I have seen examples from San Diego Co., Pasadena, Mt. Wilson, Stanford University, Mt. Tamalpais, Alameda, Cazadero, Bryson, and Cayton, California. These have the last ventral segment of the female about as in *californica* but differ in their stouter form and banded elytra.

Type: Female, No. 1783, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, September 22, 1923, in **Mill Creek Cañon, San Bernardino Mts., Calif.**; *allotype,* male, No. 1784, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 1, 1918, at Colestin, Oregon.

26. **Aligia colei** Van Duzee, new species

Related to *californica* but more strongly colored with more produced vertex and truncate female segment. Length 5 mm.

Head wider but scarcely shorter than pronotum, flat, produced in a right angle and subacute at tip, the margin rounded; elytral venation conspicuous. Last ventral segment of female nearly truncate, the apex slightly produced and notched. Valve of male scarcely angled; plates somewhat longer than broad at base, becoming narrow at apex; sides concavely arcuated, apices diverging, brown with pale basal area, the tips and bristles white. In this species the sides of the front are a little more arcuated and the clypeus is wider than in *californica.*

Color testaceous tinged with fulvous on vertex, scutellum and anterior margin of pronotum; markings of vertex as in *californica* with the three pairs of points larger, one pair at apex and one next each eye; pronotum with a whitish longitudinal median line; markings of scutellum as in *californica* but darker; elytra whitish hyaline with heavy fuscous venation; a transverse dusky band at middle and another before apex sometimes indicated; commissure with three white areas followed by fuscous marks against the tips of the nervures; apex of membrane more or less clouded with dark; beneath pale varied with fuscous; anterior femora biannulate with fuscous before, the intermediate with a subapical annulus; face with distinct arcs, its median line and disk of cheeks and loræ pale.

Described from one male and four females taken in Mill Creek Cañon, San Bernardino Mts., 3800 ft. elevation. The sharper vertex, more truncate female segment and banded femora will distinguish this species from *inscripta* and *californica.* The markings are stronger than in *californica* and usually the transverse bands are indicated. I take pleasure in naming this species for our dipterist, Dr. F. R. Cole, formerly of Redlands, California, whose guest I was, and near whose summer cottage I took the species.

Type: Male, No. 1785, and *allotype,* female, No. 1786, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, September 22, 1923, in **Mill Creek Cañon, California.**

27. **Aligia modesta occidentalis** Van Duzee, new subspecies

Differs from the eastern form of the species in being more slender in all parts, in being more strongly colored, in having the vertex very feebly angled and the last ventral segment of the female slightly produced and notched at the middle. Eleven specimens, all females, are in the Academy collection. They were taken in California as follows: Mt. Diablo, July 14, 1916; Niles Cañon, July 15, 1916; Cloverdale, August 3, 1916; Cayton, July 17, 1918; and Sonoma Valley, August 1916 (W. M. Giffard) all taken on oaks. Also taken by Mr. Giffard in Placer Co., Calif., August 19, 1916. What I believe to be the male of this form I took at Laurel Dell, Lake Co., Calif., August 3, 1916, and Mr. Giffard took a second example in Placer Co., August 19, 1916.

Type: Female, No. 1787, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 14, 1916, on **Mt. Diablo, California.**

28. **Platymetopius diabolus** Van Duzee, new species

Near *nasutus,* vertex shorter, pronotum broader, elytra longer, vertex strongly banded; face yellow; legs and beneath mostly black; male valve pointed. Length 4-4.5 mm.

Vertex one half longer than wide, right angled; pronotum considerably wider than head, four-fifths as long as vertex. Female segment rather

short, roundedly truncate, slightly produced either side of a small median notch; pygofer stout, two and a half times as long as ultimate segment. Valve of male broad-triangular, as long as wide, apex subacutely angled; plates as broad as valve, blunt at apex, surpassing valve by less than its length; pygofers considerably exceeding plates.

Color cinereous; vertex black dotted with brown posteriorly, crossed by a broad, slightly angled yellow band which sometimes is broken into four spots; apex irregularly yellow; pronotum sprinkled with black transverse dashes, especially anteriorly, the sides almost clear; anterior margin smooth, yellow; scutellum varied with black and yellow; elytra quite regularly varied with fuscous and whitish obscuring the ordinary round white spots; veins fuscous, mostly slenderly edged with pale; a band across the anteapical areoles and the apex more heavily marked, with a whiter band including the apical transverse veins and forming a large round spot beyond apex of clavus; face pale yellow to fulvous; base of front pale and irrorate, with the angled vitta traceable but little either side the middle; extreme tip of clypeus black; legs and pectus black; tibiæ pale, dotted; abdomen varied with brown and black, the genitalia pale, especially the male valve.

Described from one male and four females taken on Mt. Diablo, California, July 14, 1916. Among the species with produced and banded vertex this may be distinguished by the pointed male valve, yellow face and black tip of the clypeus.

Type: Male, No. 1788, and *allotype*, female, No. 1789, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 14, 1916, on **Mt. Diablo, California.** *Paratypes*, same data.

29. **Platymetopius planus** Van Duzee, new species

Size and aspect of *oregonensis;* vertex broader and flatter, with the pronotum nearly immaculate; genitalic characters very distinct. Length 5 mm.

Vertex flat, horizontal, scarcely impressed before apex; its length equal to width between the eyes; sides subacute, rectilinear; apex subacute; pronotal angles not prominent. Front unusually wide for the genus, width between antennæ one half the length; clypeus moderately constricted at middle. Elytral venation indistinct on disk, transverse costal veinlets scarcely oblique. Genital pieces small; valve obtuse-triangular, about as long as apical width of clypeus; plates obtuse, not wider than valve, about as long as clypeus, distinctly exceeding the broad truncate pygofers. Female segment short, truncate, about one half as long as wide,

with a conspicuous notch and rather deep sinuation either side the center, the sides oblique; pygofers short, hardly one-half longer than wide.

Color light fulvous as in *oregonensis;* vertex paler with edge and median line pale; elytra apparently opaque over the tergum; a round white spot in each of the areoles and between the costal veinlets, the basal and claval areoles with a few obscure spots; beneath pale.

Described from four males and three females taken by me as follows: McCloud, Siskiyou Co., July 23, 1918; Sisson, July 25, 26, 1918; Cayton, July 15, 1918; Mt. Tamalpais, June 23, 1918, all in California. The broad flat horizontal vertex, transverse costal veinlets and peculiar genital characters will distinguish this very distinct species.

Type: Male, No. 1790, and *allotype,* female, No. 1791, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 15, 1918, at **Cayton, Shasta Co., California.**

30. **Platymetopius pexatus** Van Duzee, new species

Related to *trilineatus* but darker with apex of vertex five-lineate with white; the colors darker, apical white spot on elytra elongated, and different male genitalia. Length 5 mm.

Head greatly produced, two and a half times as long as wide between the eyes; sides straight or slightly concave in female, the narrow tip rounded; face concave in profile; front transversely strongly convex between the eyes, four times as long as wide between the antennæ; clypeus strongly widened at apex. Last ventral segment of female short, subangulate at apex where there is a small but distinct notch; pygofers short, hardly twice longer than ultimate segment, bristles short and stout. Male valve large, rounded-triangular, sides rectilinear or nearly so; plates small, much narrower than valve or pygofers, exceeding the valve by one-half its length and reaching basad but little more than half the length of the valve, sides sinuate, apices narrow, rounded; pygofers stout, blunt, exceeding the plates by little more than half the length of the valve.

Color fulvous varied with fuscous and pale; vertex whitish, closely longitudinally vermiculate with fuscous, forming four fuscous lines before the middle thus leaving five pale vittæ, three as in *trilineatus* and one marginal either side; pronotum with seven, scutellum with four obscure pale vittæ; elytra deep fulvous-brown, especially on the disk, opaque; veins distinct; round white spots obscure basally, three on the commissural margin larger, those of the outer apical and subapical areoles

elongated, oblique; costa with about five oblique white spots alternating with the black veins; wings infuscated; face lightly infuscated, obscurely irrorate; basal line conspicuous; apex with a white dot; beneath fulvous-brown varied with fuscous; tibiæ paler, with black dots.

Described from three females and a male taken by Mr. W. M. Giffard in Placer Co., Calif., August 20, 1916, at 3000 ft.; a female taken by me at Descanso, San Diego Co., October 18, 1913, and a female from Mill Creek Cañon, San Bernardino Mts., Calif., taken September 22, 1923. With the latter I took three females I believe to be *trilineatus* Ball beaten from yerba santa. They differ from Ball's description only in being more fulvous and in having the lateral lines of the vertex more distinct.

Type: Female, No. 1792, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, September 22, 1923, in **Mill Creek Cañon, San Bernardino Mts., California.**

31. **Deltocephalus discessus** Van Duzee, new species

Closely allied to *signatifrons;* proportionately broader and shorter; vertex longer and flatter; valve of male shorter and broadly rounded; plates narrower; pygofers longer, surpassing the plates by about the median length of the plates. Ultimate ventral segment of female shorter, truncate, its outer angles a little longer and roundedly prominent; inner angles rounding to a shallow, narrow, median notch, the fundus of this notch touching an obscure rounded pale lobe, somewhat as in *signatifrons;* pygofers broader and proportionately shorter than in the related species. Colors a little darker than in typical *signatifrons,* with more black on the legs and venter; markings of the legs and vertex substantially the same. Length 2.75 mm.

Described from two females and seven males taken by me at Pine Valley, San Diego Co., California, at 4000 feet elevation. This possibly should be considered as a mere race of *signatifrons* but it seems to me best to give it specific rank as typical *signatifrons* has been taken at Keen Camp in the San Jacinto Mts., but a little farther north, and at Blitzen River, Oregon.

Type: Male, No. 1793, and *allotype,* female, No. 1794, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 24, 1920, at **Pine Valley, California.**

32. **Deltocephalus cahuilla** Van Duzee, new species

Near *miscellus* Ball; pale yellow with two to four spots at apex of vertex and a few marks on elytra fuscous; vertex produced, triangular. Length 3.4 mm.

Head wider than pronotum; vertex flat, produced and right angled before; apex subacute as in *miscellus;* sides of front slightly approaching at apex; clypeus oblong, slightly narrowed to the feebly rounded apex; cheeks unusually wide beyond the loræ; pronotum scarcely shorter than vertex, feebly sinuated behind; anterior curve of pronotum occupying two-thirds its length; elytra wide, equalling or a little exceeding the abdomen; costa well arcuated. Ultimate ventral segment of female short, as long as the penultimate, apex cut squarely off, with a rounded notch either side of an equal and rounded median lobe. Valve of male large, broadly rounded; plates short, exceeding valve by two-thirds its length, their sides straight and apices rounded; pygofers about equalling the plates.

Color yellowish white, deepened on head, anterior margin of pronotum and scutellum; vertex with about four marginal spots, two apical and two nearer the ocelli, fuscous, the latter pair often obsolete or sometimes accompanied by a pale brownish cloud inwardly; base often with two darker oblique dashes either side; elytra subopaque, polished; veins pale, sometimes obscurely edged with brown toward apex; in pale examples there is usually a fuscous mark on disk of clavus, one on the commissure, one against the first cross-vein on corium, and possibly one at apex of inner apical areole; apex often with an incomplete fuscous vitta; face pale with brown marks toward apex, sutures black; legs pale; abdomen black, segmental margins and more or less of venter pale; pleuræ embrowned.

Described from numerous examples taken by me at Keen Camp, San Jacinto Mts., California, June 6-12, 1917, and a series taken by Mr. W. M. Giffard at Pine Valley, San Diego Co., April 24, 1920, all swept from grass.

Type: Male, No. 1795, and *allotype,* female, No. 1796, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 10, 1917, at **Keen Camp, California.**

33. **Deltocephalus zephyrius** Van Duzee, new species

Apparently closely related to *nigriventer* but with darker elytra, vertex wanting the transverse band, clypeus constricted and ultimate ventral segment of female rounded at sides. Length 2.75-3 mm.

Head wider than pronotum, convex in both diameters, the anterior edge broadly rounded to front as in Euscelis; apex produced in somewhat less than a right angle; pronotum slightly longer than vertex, its curve anteriorly occupying two-thirds its length; elytra longer than abdomen, nervures distinct; face typical of genus, the clypeus moderately constricted, apex rounded, scarcely equalling the cheeks. Ultimate ventral segment of female rather long, bilobed, the outer angles rounded, median line incised almost to base and overlapping as in *nigriventer*. Male genitalia about as in *nigriventer;* valve short, feebly angled; plates large, transversely convex, sides feebly sinuate, becoming oblique to the rounded reflexed apex; bristles long, pale.

Color cinereous-brown, tinged with yellow on head and scutellum; vertex with a round black spot within and behind each ocellus; apex sometimes with a pair of faint spots; incised line scarcely darker; anterior margin of pronotum paler; elytra subopaque; nervures white, mostly edged with fuscous, the transverse veins more conspicuously white; face pale, the sutures, about six arcs on front and apical spot on clypeus fuscous; subantennal cavities black; legs mostly pale, the hind tibiæ black in female, edges and spines pale; pectus and abdomen black, sides of male valve narrowly pale.

Described from four male and five female examples taken by me at Forks, Clallam Co., Wash., July 4, 1920. This species has the genital characters of *nigriventer* almost exactly but it is in no way related to *compactus,* the form of the head and color characters separating it widely from that species. Two brachypterous specimens are paler and have the elytra a little shorter than the abdomen. *Deltocephalus contrarasi* Van D. from Sonora is larger with a shorter vertex and thickened elytra with very pale veins. It has, however, the same convex rounded vertex and is certainly related.

Type: Male, No. 1797, and *allotype,* female, No. 1798, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 4, 1920, at **Forks, Washington.**

34. **Scaphoideus nugax** Van Duzee, new species

Allied to *scalaris;* with shorter elytra but with the same form of head; fulvous yellow, deepened on disk of elytra. Length 4 mm.

Male: Head distinctly narrower than pronotum; vertex subacutely pointed, not depressed, edge rounded, length on median line equal to width between the eyes; elytra subhyaline, veins distinct, three or four supernumerary veinlets on clavus, claval veins not hooked on commissure. Valve broad, triangular; plates twice longer than valve, acutely triangular, sides sinuated, marginal bristles stout.

Color clear fulvous yellow, deeper on disk of elytra above the tergum; base of vertex, anterior margin of pronotum and edge of scutellum posteriorly whitish, apical areoles of elytra considerably enfumed, the elytral veins paler, transverse veins and apex of claval veins thickened and white; beneath and legs pale, dots at base of tibial spines scarcely darker.

Type: Male, No. 1799, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 5, 1923, at **Mill Valley, Marin Co., California.** *Paratype,* one male, taken by J. C. Bradley at Berkeley, Calif., in August, 1908, in collection of the author.

35. **Scaphoideus mirus** Van Duzee, new species

Form and aspect of *albonotatus* but with the shorter and rounded head of Euscelis; color cinereous with an immaculate yellowish vertex and variegated elytra with three pale commissural areas; Female segment very characteristic. Length 5 mm.

Female: Head slightly wider than pronotum; roundedly subangulate before; vertex convex, broadly rounded to the front, length next the eye three fifths that on median line; front wide for this genus, its basal width five sevenths its length, sides below antennæ rounded to clypeus, the latter much constricted near base with its sides straight and apex rounded; loræ large, one half as broad as long; antennal setæ elongated. Pronotum a third longer than vertex, humeri subangulate. Elytra with two or three supernumerary veinlets in clavus and two in costal areole beyond node. Last ventral segment with median third produced in a long parallel tongue to the middle of the pygofers, apex of this strap-shaped piece cleft to about its middle leaving a long subacute tooth lying either side of the oviduct; exterior to this central process the margin forms a rounded tooth-like lobe, separated from the median process by an acute notch, and outwardly slopes away to the rounded lateral angles. Valve of

male very short, subtriangular; plates about four times the length of the valve but hardly half the length of the long pygofers, obtusely triangular with the sides feebly sinuate.

Color cinereous; vertex pale yellowish. Immaculate; pronotum scarcely irrorate in the type; elytral nervures fuscous, the disk of the larger and of the apical areoles largely fuscous, including rounded whitish spots; front fulvous-brown with pale arcs and median line; clypeus, loræ and cheeks pale yellowish, the latter with a blackish cloud exteriorly; beneath pale, feet and pleural pieces more or less clouded with fuscous; tergum black; antennæ with subapical annulus and most of seta black.

Type: Female, No. 1800, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 10, 1923, on creosote bush, at **Potholes, Imperial Co., California.** *Allotype*, male, No. 1801, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 16, 1917, at Coachella, Riverside Co., Calif. *Paratype*, one damaged female taken with the allotype. In the allotype the pygofers are shaped exactly as in the female but without the oviduct and with the male plates and valve. It is not unlikely this specimen may be an hermaphrodite in which case the characters of the male genitalia may have become much modified from the form normal for the species.

36. **Euscelis gentilis** Van Duzee, new species

Apparently allied to *shastus* Ball; form and aspect of *relativus* nearly; smaller with shorter pronotum and more pointed vertex; soiled yellowish-testaceous with a black dot behind each ocellus connected by a brown band and with two brown dots on pronotum anteriorly. Length 4.5 mm.

Head a little wider than pronotum, bluntly triangular before; vertex flat on the disk and a little sloping, one-half wider than long; front rather narrow for this genus, a little longer than wide between the ocelli, sides straight above, converging a little to apex; clypeus oblong, parallel, rounded at apex. Pronotum short, a little more than twice wider than long; latero-posterior margins almost reaching the eyes; Elytra long as in *relativus;* clavus and apex with several supernumerary transverse veins, texture subcoreaceous. Last ventral segment of female short, trisinuate, the middle broadly, slightly, produced, the angles more prominently so; pygofers broad but not subangulate. Valve of male short, broad-triangular; plates long-triangular, obtuse, four times longer than valve, sides feebly arcuate.

Color soiled yellowish-testaceous, a little clearer on head and scutellum; vertex with a round black spot behind each ocellus, a faint brown cloud connecting these spots and some marks near anterior margin more or less apparent; pronotum faintly varied with brownish, with two median brown marks anteriorly; elytral veins pale, more or less distinctly edged with brown, more apparent apically; front with fuscous arcs and pale median line; tergum, pleuræ and base of venter marked with brown, more extended in male; ocelli pink; hind tibiæ with faint brown points at base of spines.

Type: Female, No. 1802, and *allotype,* male, No. 1803, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, August 2, 1916, at **Hobergs Resort, Lake Co., California.**

37. **Euscelis almus** Van Duzee, new species

Allied to *frigidus* Ball, a little narrower with more pointed head; vertex with three round black spots one of which is discal; elytra faintly fuliginous with pale nervures and fuscous marks in apical areoles. Length 4 mm.

Head a little wider than pronotum, vertex nearly horizontal at base, broadly rounded to base of front, polished. Front moderately broad, one-half longer than broad, nearly flat; sides slightly narrowed to apex; clypeus oblong, apex rounded, sides feebly excavated; loræ narrow. Pronotum a little longer than vertex, outer angles broadly rounded. Elytra with one or two supernumerary cross veins near apex of costa. Last ventral segment of female rather deeply, angularly excavated. Valve of male longer than ultimate segment, roundingly triangular; plates long, obtuse at apex, sides feebly arcuated, contracted at base.

Color pale yellowish, deeper on head; vertex with three round black spots, the median paler, placed forward of the lateral and minutely notched before; lateral placed near the eyes and just above the line of the ocelli; face with a row of four large black spots below the margin, the lateral on the temples above the antennæ; sutures of the face and about six arcs fuscous; pronotum scarcely darkened across the disk and on anterior margin; scutellum usually with black spots near basal angles and two brown discal dots, apical field sometimes with two brown spots. Elytra pale smoky with conspicuous pale nervures; apical transverse veins marked with brown and a brown vitta borders the apical veins; pleural pieces and abdomen more or less black, the last ventral segment of female with a black spot at fundus of notch; suture and dorsum of male pygofers black; legs pale, claws black.

Described from three male and three female specimens. The seven large round black spots on head (three on vertex and four below margin) are a conspicuous character of this species. While recalling *frigidus* the characters of the head and elytra place this species in subgenus Conosanus.

Type: Female, No. 1804, and *allotype*, male, No. 1805, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 23, 1918, at **Los Baños, Merced Co., California.**

38. **Euscelis finitimus** Van Duzee, new species

Color and aspect somewhat of the female of *Eutettix bartschi* but with the front and vertex of Euscelis; polished light fulvous brown with pale veins and irrorations; vertex with a black mark behind the eyes. Length 5 mm.

Head little wider than pronotum, obtusely angled; vertex nearly flat, about two-thirds wider than long; front broad, its length and width subequal, sides straight above, incurved to clypeus, abruptly raised above level of cheeks; clypeus oblong, a little narrowed to the rounded apex; pronotum long, twice as long as vertex, sides broadly rounded behind the eyes; elytra shaped much as in *Eutettix subaenea* with arcuate costa and flaring tips, with four or five supernumerary veinlets in outer areole of clavus. Last ventral segment of female broadly excavated, the outer angles subacute, middle with a broad short lobate tooth which is feebly angled; pygofers short and broad. Valve of male short, broad-triangular and convex, a little shorter than the pygofers.

Color light fulvous brown, clearer beneath, polished; vertex with an angular black mark on each side between ocellus and eye, but showing a tendency to being drawn out into a transverse band; anterior to these spots are two curved darker lines either side the middle and another indicated near the hind margin; pronotum irrorate with pale, with a large pale area behind the eyes; elytral nervures, except the marginal, pale; minute points at base of tibial spines and claws black.

The polished fulvous surface gives this insect somewhat the aspect of a Eutettix but it is a Euscelis of the Conosanus group.

Type: Female, No. 1806, and *allotype,* male, No. 1807, Mus Calif. Acad. Sci., collected by E. P. Van Duzee, July 31, 1918, at **Colestin, Oregon.**

39. **Lonatura pupa** Van Duzee, new species

Closely allied to *minuta* Van Duzee, a little larger with a longer vertex and different form of last ventral segment. Length 3 mm.

Macropterous female: Vertex a little longer than width between the eyes, forming a right angle, with the apex obtuse; surface convex as in *minuta.* Elytra a little longer than abdomen; nervures distinct; second cross-nervure prominent; front a fourth longer than wide, rather abruptly narrowing to clypeus, the latter narrower at apex with the sides straight. Ultimate ventral segment one half longer than preceding, arcuately narrowing to a bluntly angular apex; pygofers slender, equalling the oviduct.

Color pale yellowish, a little more deeply colored on head, paler beneath; elytra subhyaline, nervures yellowish; tergum and oviduct mostly black; eyes brown; ocelli and tip of rostrum black.

Lonatura nana Van D. from the Gulf of California region is wider with very different ultimate segment.

Type: Female, No. 1808, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, July 12, 1922, at **Saltair, Utah.** *Paratypes,* two females, same data.

40. **Thamnotettix lenis** Van Duzee, new species

Size and aspect of *helvinus* Van D.; a small green species with yellow pointed head, dark front and short truncate male plates. Length, male, 4.75 mm., female, 5.5 mm.

Head much wider than pronotum; vertex acutely triangular, almost as long as width between the eyes; front narrow, almost one-half longer than wide, base acutely angled, profile slightly concave; sides straight, but slightly contracted at base of clypeus; the latter parallel sided, but little narrowed at apex. Last ventral segment of female rather long, apical margin broadly arquate, with a shallow notch either side the median line, leaving a broad short median tooth which is minutely emarginate and is included in a black cloud lying behind each sinus; pygofers short and stout, not twice longer than wide and almost entirely clothed with long stout bristles. Valve of male large, obtusely triangular; plates as long on median line as the valve, cut off square at tip, sides straight; pygofers narrow, exceeding plates by the median length of the plates, closely clothed with stout white bristles as in the female.

Color light green becoming yellow on vertex, anterior margin of pronotum and on the scutellum, apex of elytra more hyaline, scarcely clouded, veins yellow; front brown with arcs and margin more or less yellow, sutures dark; pleuræ and abdomen black, margins, apex of abdomen, edge of male valve and last ventral segment and the pygofers of female yellow; male plates whitish, the pygofers black; legs pale, the pale spines set in small brown dots.

The unusually pointed head and peculiar genitalia will distinguish this small green species.

Type: Male, No. 1809, and *allotype*, female, No. 1810, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 18, 1920, at **Bryson, Monterey Co., California.** *Paratypes*, two males, two females, taken as follows: Bradley, Monterey Co., California, April 23, 1917 (E. P. Van Duzee); Santa Cruz, California, June 8, 1917 (W. M. Giffard).

41. **Thamnotettix verutus** Van Duzee, new species

Near *vastula* in size, form and color but with distinct genitalia; light green, more yellowish on head and scutellum; apex of elytra smoky; male plates large, triangular, exceeding the pygofers. Length 5.5 mm.

Male: Head well produced, right-angled before, apex subacute; vertex flat, broadly rounding to the front; front strongly convex transversely, as long as wide, sides straight above, gently rounding to the clypeus, the latter rectangular, with straight sides. Pronotum scarcely shorter than vertex; more deeply excavated behind than in *vastula*. Valve broad, short, slightly angled; plates, taken together, rather longer than their basal width and distinctly exceeding the pygofers, triangular, subacute at apex, their sides very feebly concave from near base.

Color clear green, becoming yellowish on head, anterior margin of pronotum and scutellum; elytra subopaque, the costa apically paler; apical areoles smoky; front paler with a brown cloud either side; tergum (except narrow margin), sternum, base of vertex and genital hooks black. Legs and their spines whitish.

Female with vertex shorter than in male. Last ventral segment narrow, constricted near base, sides beyond gradually approaching, outer angles rounded; middle one-half shallowly excavated, base of excavation straight, impressed and blackened; oviduct black, considerably exceeding the pygofers.

Described from a good series taken by me as follows: Bryson, Calif., April 24, 1917, May 18-20, 1920; Bradley, Calif., April 23, 1917, May 22, 1920; Soboba Springs, Riverside Co., Calif., May 30, 1917; San Jacinto, Calif., May 29, 1917; Dixon, Calif., June 3, 1920. Also taken in Shasta Co., Calif., July 17, 1921, by J. A. Kusche. Like all its green allies this species when teneral has a pale bluish look from the black tergum showing through the imperfectly pigmented elytra. The large triangular, scarcely excavated plates of the male will distinguish this species.

Type: Male, No. 1811, and *allotype*, female, No. 1812, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, May 20, 1920, at Bryson, Monterey County, California.

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XVIII

PALEONTOLOGY OF COYOTE MOUNTAIN, IMPERIAL COUNTY, CALIFORNIA

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Introduction

When I assumed the duties of Curator of the Department of Paleontology in 1919, I found in the Department two large collections of fossil mollusks from Coyote Mountain, Imperial County, California. These had been borrowed for study and report by former Curator, Roy E. Dickerson, and he had done a very considerable amount of work in the identification of the species. Up to the time of his departure, he was unable to complete the work to his satisfaction, and in 1920, he turned the matter over to me either to finish or return the collections to their owners. After due consideration, the advice of Dr. J. P. Smith and Dr. B. L. Clark was taken and the work of identification was completed as nearly as possible and the collections were returned.

Publication has been withheld until this time because it was found that the fauna needed for critical comparison was to be had only in the Gulf of California. Until the Academy sent its expedition there in 1921, no collection of consequence was available in any western museum for consultation. That year, through the untiring industry of Dr. Fred Baker, a very large number of the known species of that province was brought back. Also through his efforts the larger forms have been identified and it has been possible to compare the Coyote Mountain fossils with them.

This procedure has prevented a very considerable number of inaccuracies which would have been inevitable had the report been published in 1921. The most fertile source of error would have been due to making comparison of this relatively poorly preserved material with living and fossil species from east American and West Indian points. Unquestionably, the Coyote Mountain fauna is closely related to that of the Atlantic, but so is the fauna of the Gulf of California. In no great number of cases does this similarity amount to exact identity of species. Without a good Gulf of California collection for comparison, grave errors would have been unavoidable.

The tropical fauna of the Gulf of California is so vastly different from any known from the California coast that with only the latter and eastern collections available, the natural

conclusion students would reach would be to associate the Coyote Mountain forms with those of the Atlantic of similar tropical facies.

Even with the Gulf of California collection for comparison, this report could hardly have been completed without the hearty cooperation of many paleontologists. Particularly must appreciation be acknowledged to Dr. Fred Baker; Dr. J. P. Smith; Dr. B. L. Clark; Dr. Roy E. Dickerson; Mrs. Kate Stephens; Mr. Chas. H. Sternberg; Dr. W. H. Dall; and Mr. W. C. Mansfield.

Location

Coyote Mountain, sometimes called Carrizo Mountain, is located in the western part of the Colorado Desert, Imperial County, California. It is close to the great granite range which extends from Mount San Jacinto on the north to Mount San Pedro Martir in Lower California.

The base of the mountain is about three miles north of Coyote Wells, a watering station on the highway from San Diego to El Centro and Yuma. The United States-Mexican boundary is about four miles south of Coyote Wells.

The crest of the mountain is a ridge about five miles long extending almost east and west. The surrounding country is excessively barren desert and most of the usual erosion-features common to such surroundings are found. Thus there are broad gravel washes, steep box cañons and many perpendicular escarpments.

North of Coyote Mountain about ten miles there is another and larger mountain mass, likewise an intrusion through Tertiary sediments, now known as Fish Creek Mountain. Between it and Coyote Mountain is the flood plain of Carrizo Creek. This is a very ancient waterway; in the granitic mountains which it traverses it has cut a great gorge, celebrated for its scenic features.

Coyote Mountain is now easily reached since it is only three miles from a paved highway. Light automobiles are usually driven almost any place on the desert floor and by following the wider washes it is possible to drive into several of the main cañons. Alverson Cañon can thus be reached.

Previous Work

The original discovery of the Coyote Mountain uplift was made by W. P. Blake, geologist with the Pacific Railroad Survey. The party with which he traveled camped on Carrizo Creek where this stream flows out of its cañon and is lost in the sands of the Colorado Desert. Here some fossils were found and collected.[1] These were subsequently described by Conrad[2] as *Ostrea heermanni, Anomia subcostata* and *Pecten deserti,* all new species and *Ostrea vespertina,* previously described from San Diego.[3] With only these four species, Conrad thought the age of the deposit from which they came was probably Miocene.

I do not find any other publication based upon original investigations until the report of Charles R. Orcutt was issued in 1890. (See bibliography for references.) He traveled extensively in the Colorado Desert at an early date, and, it appears, made large collections of fossils from the marine sediments in the Coyote Mountain district. He mentioned particularly corals and oysters. Much of his data was reprinted in 1901.

H. W. Fairbanks next collected in the region about 1892 and some of the corals he secured were sent to Dr. T. W. Vaughan who described them in 1900. There were two species and one subspecies of these.

Dr. Stephen Bowers made another collection of corals in 1901 and published a short paper on his observations. This collection was likewise studied by Dr. Vaughan, who published some notes on it in *Science* in 1904.

This latter collection was so interesting that Dr. Vaughan arranged to have Dr. Bowers and Mr. W. C. Mendenhall visit the locality and a very much more extensive collection was made. A brief list of some of the Mollusca contained in the collection was published in 1906 by Dr. Ralph Arnold. He also included a preliminary list of the corals and described two new species of *Pecten* from the locality. As a result of

[1] See Blake, Pac. R. R. Repts., Vol. 5, 1857, pp. 120-123.

[2] Op. cit., pp. 325-326, pl. 5. The original descriptions (without illustrations) appeared in an octavo appendix to the preliminary report of the geologist of the survey, published in 1855 as House Executive document 129, 33rd Cong. 1st Sess.; citations are usually made to the final quarto report in Vol. 5.

[3] It so happens that descriptions of the two first mentioned appeared in February, 1855, without illustrations in Proceedings of the Academy of Natural Science of Philadelphia, p. 257.

Mr. Mendenhall's visit, he published in 1910 the most extensive account we have of the geology of the district.

One of the sea urchins collected in 1904 was appropriately described the same year by Charles E. Weaver as *Clypeaster bowersi.*

Dr. John C. Merriam of the University of California recognized the importance of this locality from a paleontological standpoint and had two large collections made there about 1911-1913. One of these was by Messrs. Kew and Buwalda; the other by Kew and English. As a result of these visits, the most extensive collections thus far taken were assembled.

In 1914 Dr. Kew published a paper on the echinoids of the region in which several new species were described. He also included a geologic sketch map and cross section of Coyote Mountain. He also published a list of the Mollusca which had been identified. Only ten of the names were given unqualifiedly and none of these were gastropods; all except four had been described from these deposits.

This paper was followed in 1916 by one by J. O. Nomland on Cretaceous and Tertiary corals of California and Oregon in which one species from Coyote Mountain was described.

In 1917 Dr. T. Wayland Vaughan published an extensive account of the corals collected in 1904 by Messrs. Mendenhall and Bowers. He made extensive comparisons with other faunas and gave a fairly complete resume of all previous work in the region. (It should be noted that the explanations beneath the two figures on Plate 93, Prof. Ppr. 98, No. 5, U. S. Geol. Sur. are reversed.)

Dr. R. E. Dickerson read a short paper before a meeting of the Geological Society of America in 1918 (published only in abstract form) in which previous views on relationships of the Coyote Mountain deposits are given. This was followed in the manuscript by a list of the Mollusca he had identified from the collections.

Many collections have been made in the region from time to time, the most important of which I have knowledge being the following:

1. The Blake collection which Conrad studied.
2. The Orcutt collections of 1888 and 1890, studied and reported upon by him.

3. The Fairbanks collection which went to the University of California and the corals of which were studied by Vaughan.
4. The Bowers collection of 1901, the corals of which were sent to Vaughan while the mollusks eventually came to the California Academy of Sciences.
5. The Mendenhall and Bowers collection of 1904 which went to the U. S. Geological Survey and the corals of which were studied by Vaughan.
6. The Kew and English collection of 1912 which went to the University of California.
7. The Kew and Buwalda collection of 1913 which went to the University of California. The echinoids of the last two collections were studied by Kew.
8. The Stephens and Sternberg collection of 1920 which went to the San Diego Society of Natural History.
9. The California Academy of Sciences collection of 1921 made by the writer.
10. Stanford University collection made at various times and by various collectors.
11. A private collection made at various times by Sternberg and distributed to several institutions.

Geology of the District

During my visits to Coyote Mountain, I examined many of the cañons minutely, but my purpose was chiefly to search for fossils. Therefore, I am not in a position to add much to the two excellent accounts of structural conditions which have been published.[4] The most important parts of these papers were quoted by Vaughan (U. S. Geol. Surv. Prof. Ppr. 98, pt. 5, 1917, pp. 355-360). In general, these observers agreed that Coyote Mountain was an island of granitic and metamorphic rocks, of possibly Carboniferous age at the time of deposition of the Tertiary sediments. This deposition was accompanied in its early stages by some volcanism of minor character. One of the most evident features as the mountain is approached, is the manner in which all strata dip away from

[4] Mendenhall, Journ. Geol. Vol. 18, 1910, pp. 336-355. Kew, Univ. Calif. Publ. Geol. Vol. 8, 1914, pp. 39-60.

the center in every direction. Erosion has cut away many of the soft clay layers and left hard sandstone or oyster reefs projecting as isolated hills in "bad land" areas. Many of the reefs are composed almost entirely of organic calcite, chiefly oysters, firmly consolidated and in one place at least partially turned to marble. In other places, there are large areas completely covered with oyster shells, anomias, pectens and barnacles. These are weathered out free, and except for an etching from the wind-blown desert sand, are in a perfect state of preservation.

Much of the core of the mountain is composed of marble and quarrying operations on a prospective scale have been carried on at many places. Unquestionably some of it is very beautiful rock.

The best fossil-collecting locality is on the south side of the mountain, a little west of the center in a wash called Alverson Cañon. Fossils occur there in many kinds of sediments, but the preservation is notoriously bad. Many of them can only be had as casts, while most of the others are so badly crystallized that the finer details of sculpture are obscured. The richest layers are sandstone, firmly cemented with calcite. Extraction of fossils from this material was found to be exceedingly difficult except in a few favorably weathered surfaces.

Age of the Deposits

Various age determinations have been made of the Tertiary sediments on the flanks of Coyote Mountain usually referred to as "Carrizo Creek" which cuts through a portion of them. Conrad, with four species of Mollusca, thought the age was Miocene.

Orcutt in 1890 supposed it to be Cretaceous, basing the decision upon the oysters and corals.

Vaughan in 1900 with two species and a subspecies of coral gave the age as "doubtfully Cretaceous."

Arnold in 1906 called it Miocene and correlated with the Etchegoin of central California which he also called Miocene, but which has been determined to be lower Pliocene.

Vaughan in 1910 gave the age as lower Miocene as determined by Messrs. Dall and Arnold.

Kew in 1914 stated that "The echinoderm fauna seems to indicate a comparatively late age, as several of the forms are very closely related to species living in the Gulf of California at the present time." In 1920 he referred all of them to the Pliocene.

In 1916 Nomland referred the coralliferous beds to the Pliocene.

Vaughan in 1917 stated that "The fauna of Carrizo Creek is related to Pliocene and Post-Pliocene faunas of Florida and the West Indies and can scarcely be older than lower Pliocene."

Dickerson followed in 1918 with a Miocene age determination correlating the sediments with the Gatun formation of Panama.

It is quite evident that considerable diversity of opinion as to the age has existed. A critical study of the Mollusca contained in the various collections I have examined, leads me to agree that the age cannot be greater than lower Pliocene and I am much inclined to the belief that the greater portion is middle and upper Pliocene.

There appears to be good reason to suspect that more than one Pliocene formation is represented on the flanks of Coyote Mountain. Very little reason exists for the placing of the coral reef, the lowermost exposed fossiliferous stratum, with the great oyster reefs of the upper part.

Names of Formations

For a long time the deposits about Coyote Mountain have been called "Carrizo Creek" beds, or "Carrizo" formation; the latter was proposed definitely in 1914 by Kew,[5] but Vaughan[6] has shown that these names are inapplicable because of prior use elsewhere. This is to be regretted, but it seems that current usage demands a different name. Since we are unable as yet to correlate definitely any of the fossil bearing strata with any named formation elsewhere, I would propose that it be known as the "Imperial Formation" in the future.

[5] Univ. Calif. Publ. Geol. Vol. 8.
[6] U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 367.

The type locality should be taken as the coral reef exposed in Alverson Cañon on the south side of the mountain.

This coral reef has a distinctive fauna. It is succeeded by about 200 feet of very fossiliferous calcareous sandstones for which I would propose the name "Latrania Sands." It is this formation which contains the large general assemblage of marine Mollusca, a representation which indicates the presence of pure ocean water.

Above the Latrania Sands there are enormous deposits of clay, the peculiar properties of which may make it of commercial value at some future time. In order that these may have a name for reference I would propose that they be called the "Coyote Mountain Clays." They are extensively developed over wide areas but the type locality has been selected in the foothills bordering the southeast slope of Coyote Mountain.

Above these clays, and interbedded with them near the top to some extent, are extensive deposits of oyster shells for which the name "Yuha Reefs" has been selected. The type locality has been chosen as a prominent hill made up of the material, thoroughly cemented and partially metamorphosed, located on the east end of the Coyote Mountain uplift. A gap between the hill and the mountain affords a good trail from Coyote Wells on the San Diego-El Centro Highway to the north side of the mountain. The same reefs are found on Yuha Buttes, Superstition Mountain, Signal Mountain, and especially near where Carrizo Creek flows out of the mountains to the westward.

The Yuha Reefs are followed by an enormous thickness of silt deposited in the freshwaters of the ancient Lake Coahuila, an appropriate name for which is the "Coahuila Silt." It is exposed where the San Diego-El Centro Highway crosses New River about a mile west of El Centro. The total thickness of these silts is not known but they contain freshwater fossils to the base of the exposure indicated.

Thus, according to the above nomenclature, Conrad's fossil mollusks came from the Yuha Reefs. Kew's echinoderms are from the Latrania Sands; and Vaughan's corals from the Imperial Formation. It is believed that further work will

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necessitate further subdivision rather than a consolidation of the above formations.

In this connection it is proper to add that Coyote Mountain has been called "Carrizo Mountain" in some reports. Also Fish Creek Mountain, the next one to the north of Carrizo Creek, has been called "Black Mountain," "Barrett Mountain," and "Fish Mountain."

Oil Possibilities

At various times attempts have been made around the flanks of Coyote Mountain to obtain oil, but I think in every case, without adequate preliminary geological investigation. If this had been made, I can see no reason for the drilling of more than one well in that vicinity. This statement is based upon the following facts:

1. No adequate source of petroleum exists. While some exposed strata are very fossiliferous, all except the oyster reefs are far from being sufficiently so to be considered as a source of petroleum in commercial quantities. The oyster reefs have no adequate cover. The great deposits of shales and clay shales are barren of organisms. The basal marbles cannot be considered at all in this connection.

2. The structure about Coyote Mountain is monoclinal; all strata dip away from the mountain. There is no known place for oil to accumulate. There is only one possible exception to this statement within a radius of five miles of the mountain, to my knowledge. Yuha Buttes, five miles to the southeast, is evidently an anticlinal, dome-shaped fold. But it was tested to a depth of over 1100 feet many years ago without evidence of oil.

Indeterminate Species

The various collections studied have contained a considerable number of species so poorly preserved that positive specific identification cannot be made. While it is true that leaving them out of the present list will give the impression that the complete fauna is smaller than it actually is, no useful purpose would appear to be served by including a lot of generic names.

The fauna of the Pliocene beds of Coyote Mountain is a large one, and if it could be seen in its entirety, it would approximate, probably, the present one of the Gulf of California in size; but induration has proceeded to such a degree that only a small portion can be obtained unless some new localities with better preservation are discovered. Mere names of genera, derived from fragments, do not give a satisfactory picture of a fauna, but they are sometimes included in lists as padding. Space is now too valuable to warrant such procedure unless some other purpose can be served.

Therefore, only those species have been included in the following pages which could be identified with reasonable assurance of their correctness. No doubt inexperience has thus caused the omission of some species which might have been included had the author been more familiar with related faunas. This loss, however, is believed to be more than offset by the inaccuracies which would have resulted from attempts to place the fragments in question.

COLLECTING STATIONS

The three largest collections studied have been appropriately numbered in the respective museums, and the following list is a transcript of the various localities from which each lot was obtained. Although collecting stations have been duplicated by the several collectors, the numbers have been kept separate, consistently, in the body of the paper, the institution to which each pertains being appropriately indicated by initial letters.

STATIONS OF THE UNIVERSITY OF CALIFORNIA

735. Near the center of the Yuha Buttes, Imperial County, California, and at the top of the anticline there; south of the main road from El Centro to San Diego; about four miles north of the Mexican boundary; W. S. W. Kew and W. E. English, colls.
736. About 200 yards south of the axis of the anticline in Yuha Buttes, Imperial County, California; W. S. W. Kew and W. E. English, colls.
737. South side of Coyote Mountain, Imperial County, California, in a wash heading northwest from the road near the base of the formation; W. S. W. Kew and W. E. English, colls. (Alverson Cañon.)

738. From two small washes on the west side of the cut made by the stream in which No. 737 is located, at the base of Coyote Mountain, Imperial County, California, west of the road from Coyote Wells to Carrizo Spring via Coyote Mountain; W. S. W. Kew, W. E. English and J. P. Buwalda, colls. (This locality is in a branch of Alverson Cañon, Original Nos. 4 and 55.)
739. At the head of the south branch of Alverson Cañon, Coyote Mountain, near the divide leading to Carrizo Creek, Imperial County, California; W. S. W. Kew and W. E. English, colls.
740. Alverson Cañon, Coyote Mountain, Imperial County, California, near the contact of lavas [?] and sandstones; W. S. W. Kew and W. E. English, colls.
2062. In wash halfway between Coyote Mountain and Carrizo Spring, Imperial County, California; Upper beds of formation; W. S. W. Kew and J. P. Buwalda, colls.; April, 1913.
2063. In Garnet Cañon, north side of Coyote Mountain, Imperial County, California; about halfway to head of cañon and from basal beds lying on the complex; W. S. W. Kew and J. P. Buwalda, colls.; May, 1913.
2064. At the head of Garnet Cañon, north side of Coyote Mountain, Imperial County, California; basal beds; W. S. W. Kew and J. P. Buwalda, colls.; May, 1913.
2065. Near the head of Garnet Cañon, Imperial County, California; hard shales containing gypsum; W. S. W. Kew and J. P. Buwalda, colls.; May, 1913.

Localities 735, 736, and 2062 are from the "Yuha Reefs"; the remainder are from the "Latrania Sands" as defined above.

STATIONS OF THE U. S. GEOLOGICAL SURVEY

3919. East end of Coyote Mountain, Imperial County, California; Stephen Bowers, coll.; 1904 (Original No. 165).
3921. "Barrett's Oil Well" about 20 miles north of the Mexican boundary, Imperial County, California; Stephen Bowers, coll. 1904 (Original No. 168). [This locality is near Carrizo Creek wash and on a direct line between Coyote Mountain and Fish Creek Mountain; See map of Mendenhall, reprinted by Vaughan.]
3922. At the head of Garnet Cañon on the north side of Coyote Mountain, Imperial County, California; Stephen Bowers, coll.; 1904 (Original No. 166).
3923. Alverson Cañon, on the south side of Coyote Mountain, Imperial County, California; Stephen Bowers and W. C. Mendenhall, colls.; 1904 (Original No. 164).
6836. Carrizo Creek, Colorado Desert, California, January, 1890.
6847. Ravine about one mile south of Alverson Cañon, Coyote Mountain, Imperial County, California; Stephen Bowers and W. C. Mendenhall, colls.; January 20, 1904 (Original No. 163).

[In addition to the above material, the U. S. National Museum probably contains some of the original specimens collected by the members of the Pacific Railroad Survey and studied by Conrad. There is also a collection of corals from Fish Creek Mountain, which has a direct bearing upon the present collections. It is No. 7616 (Original No. 167). (See Vaughan, U. S. Geological Survey Prof. Ppr. 98, 1916, p. 350.) Localities 3919, 3921, 6836 and 6847 are supposed to have come from the "Yuha Reefs"; localities 3922 and 3923 contain material from both the "Latrania Sands" and "Imperial Formation" as defined above.]

Stations of the California Academy of Sciences

680. Alverson Cañon, Coyote Mountain, Imperial County, California; from coarse sandy limestone above coral reef.
681. Alverson Cañon, Coyote Mountain, Imperial County, California; from the coral reef which crosses the cañon toward its source.
682. From the first narrow, box cañon east of Alverson Cañon, Coyote Mountain, Imperial County, California.
683. From the second cañon east of Alverson Cañon, Coyote Mountain, Imperial County, California.
684 North side of Coyote Mountain, Imperial County, California; from cañon one-half mile north of road to marble quarry but west of red hills on north side of road.
685. Northeast corner of Coyote Mountain, Imperial County, California; from a bank 100 yards south of road to marble quarry; in the flat between red hills on the north and Coyote Mountain on the south.
686. One mile northwest of James Well, east of Coyote Mountain, Imperial County, California; from a high projection of a solid shell reef; the reef dips east about 30°.
687. From a clay shale layer which underlies the shell reef hill (No. 686), Coyote Mountain, Imperial County, California.
688. From a wash two miles west of James Well and one mile south of base of Coyote Mountain, Imperial County, California.
689. Oyster reef near same place as No. 688.
690. From first knoll northwest of the shell reef hill (No. 686), Coyote Mountain, Imperial County, California.
691. Uppermost layers one mile northwest of James Well and east of base of Coyote Mountain, Imperial County, California.
692. Oyster bed one-half mile northeast of James Well and two miles northeast of base of Coyote Mountain, Imperial County, California.
693. Yuha Buttes, Imperial County, California.

701. A miscellaneous collection of fossils received without definite locality data, other than Coyote Mountain, Imperial County, California, from California State Mining Bureau, collected by Dr. Stephen Bowers.

[All of the above Academy collections except No. 701 were made by the writer in January, 1921. Localities 680, 682-685 are from the "Latrania Sands"; locality 681 is from the Imperial Formation; localities 686-693 are from the "Yuha Reefs" as defined above.]

Bibliography

The following list of titles is not intended to be complete for the whole of the desert region of southeastern California. Only those references are given which pertain to the geology of the vicinity of Coyote Mountain, and which have been used in the preparation of this paper. A long list which deals with other phases of the interesting region, particularly Imperial Valley and the Salton Sea, has been intentionally omitted because they have no direct bearing on the paleontology of the district here treated. One exception is made in the case of a detailed account of desert trails and watering places, a publication of incalculable value to any one who may make explorations of any kind in the region.

Arnold, Ralph—The faunal relations of the Carrizo Creek Beds of California. Science, n. s., Vol. 19, 1904, p. 503.

.................—Paleontology of the Coalinga District, Fresno and Kings counties, California. U. S. Geol. Surv. Bull. 396, 1909. On p. 44 the Carrizo Creek formation is correlated with the Etchegoin of San Joaquin Valley upon the presence of *Pecten deserti* Conrad.

Blake, Wm. P.—Pacific Railroad Survey Reports, Vol. 5, 1857, pp. 108, 120-123. On the pages cited is given an account of the occurrence of the fossils at the mouth of Carrizo Creek.

Bowers, Stephen—Reconnaissance of the Colorado Desert Mining District. California State Mining Bureau, separate publication, 1901, 19 pp.

Brown, J. S.—Routes to Desert Watering Places in the Salton Sea Region, California. U. S. Geol. Survey Water Supply Paper No. 490-a, 1920. The same, much enlarged and with a great deal of general information, by the same author appeared as "The Salton Sea Region of California." U. S. Geol. Surv. Water Supply Paper No. 497, 1923, pp. 1-292; maps.

CONRAD, T. A.—Pacific Railroad Survey Reports, Vol. 5 (Geology), 1857, App. 2, pp. 325-326, pl. 5. Four species of fossil Mollusca are described from a locality near where Carrizo Creek flows out of the mountains on the west to the valley floor. A footnote on the title page states that the descriptions were originally published in 1855 in the appendix to the Preliminary Report on Geology by Wm. P. Blake. See House Executive Document, No. 129, 33rd Cong. 1st Sess. 1855.

DICKERSON, R. E.—Mollusca of the Carrizo Creek Beds and their Carribean Affinities. (Abstract), Geol. Soc. Am. Bull. 29, 1918, p. 148.

FAIRBANKS, H. W.—Eleventh Ann. Rept. Calif. State Mineralogist, 1893, pp. 88, 90.

KEW, WM. S. W.—Tertiary Echinoids of the Carrizo Creek Region in the Colorado Desert. Univ. Calif. Publ. Bull. Dept. Geol. Vol. 8, 1914, pp. 39-60.

..................Cretaceous and Cenozoic Echinoidea of the Pacific Coast of North America. Univ. Calif. Publ. Geol. Vol. 12, No. 2, 1920. The Coyote Mountain echinoderms are redescribed in this paper.

MENDENHALL, W. C.—Notes on the Geology of Carrizo Mountain, San Diego County, California. Journal of Geology, Vol. 18, 1910, pp. 336-355.

MERRILL, J. H.—Geology and Mineral Resources of San Diego and Imperial counties (California). Advance Report Calif. State Mineralogist, Dec. 1914, pp. 1-113. The same was reprinted in 1916 as a part of the 14th Ann. Rept. Calif. St. Min. for 1913-1914 pp. 633-743. Much information on the geology of Imperial County is contained in this report. On p. 105 is reproduced a photograph showing borings of marine mollusks in marble on the slopes of Coyote Mountain. At the end of the paper, 20 references to places in the State Mining Bureau's publications are cited which deal with the geology or mineral resources of Imperial County; most of these treat of mining operations.

NOMLAND, J. O.—Corals from the Cretaceous and Tertiary of California and Oregon. Univ. of Calif. Publ. Bull. Dept. Geol. Vol. 9, 1916, pp. 59-76.

ORCUTT, CHARLES R.—Geology of the Colorado Desert. 10th Ann. Rep. Cal. State Min. for 1890, pp. 899-919. A bibliography and long account of the fossils are given.

..................—The Colorado Desert. West Am. Scientist, Vol. 12, No. 102, 1901.

VAUGHAN, T. W.—A Californian Tertiary Coral Reef and its bearing on American Recent Coral Faunas. Science N. S. Vol. 19, 1904, p. 503.

..................—The Eocene and Lower Oligocene Coral Faunas of the United States. U. S. Geol. Surv. Monog. No. 39, 1900. On pp. 142 and 151, pls. 15, 17, three Imperial County corals are described.

VAUGHAN, T. W.—In Arnold, Tertiary and Quaternary Pectens of California. U. S. Geol. Surv. Prof. Ppr. 47, 1906. On p. 22, is given a list of Coyote Mountain fossil corals; some new names without descriptions appear.

.. . .—The Reef-coral Fauna of Carrizo Creek, Imperial County, California, and its Significance. U. S. Geol. Surv. Prof. Ppr. 98, pt. 5, 1917, pp. 355-386, pls. 94-102. This important paper gives a complete resume of the geology of the district up to the date of publication.

WEAVER, C. E.—New Echinoids from the Tertiary of California. Univ. Calif. Publ. Geol. Vol. 5, 1908, pp. 271-274

GASTROPODA

1. **Architectonica quadriceps** Hinds

Plate 20, figures 5, 6

Specimens examined

Locality	Collection	Number
55	U.C.	5
738	U.C.	3
681	C.A.S.	1
6847	U.S.G.S.	1

The best preserved one of the above (Loc. 738, U.C.) has been figured. All have been crystallized and this has tended to obscure the fine sculpture. In size, shape, and sculpture the fossils agree very well with the figure of *quadriceps* given by Tryon,[7] but the spiral cords are not broken into beads as in the Gulf of California species commonly called *granulata S. quadriceps* was described from Panama.[8]

2. **Bullaria striata** Bruguiére

Plate 20, figure 9

Bulla striata BRUG. PILSBRY, Man. Conch. Vol. 15, 1893, p. 332, pl. 37, figs. 42-46.

Bullaria striata attenuata DALL, Trans. Wagner Free Inst. Sci. Vol. 3, pt. 2, 1892, p. 219, pl. 13, fig. 10a.

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[7] TRYON, Man. Conch. Vol. 9, 1887, p. 10, pl. 4, figs. 39, 40.
[8] HINDS, Proc. Zool. Soc. London, 1844, p. 23.

Bulla paupercula SOWERBY, Quart. Journ. Geol. Soc. London, Vol. 6, 1849, p. 52—GABB, Trans. Amer. Phil. Soc. Vol. 15, 1873, p. 246—GUPPY, Quart. Journ. Geol. Soc. Lond., Vol. 32, 1876, p. 518.

Bullaria paupercula SOWERBY, MAURY, Bull. Am. Pal. No. 29, 1917, p. 182, pl. 3, fig. 8.

Specimens examined

Locality	Collection	Number
680	C.A.S.	1
682	C.A.S.	13
3922	U.S.G.S.	2
3923	U.S.G.S.	2
6847	U.S.G.S.	5

B. striata is a species now found living in the Mediterranean Sea and Pilsbry has shown that the West Indian living shells, usually called *B. amygdala* Dillwin, cannot be separated from it.

Dall[9] listed the species as *striata* from the Bowden, Jamaica deposits, which were then thought to be Oligocene in age. Maury, however, continued to use the name *paupercula* for the fossils from Santo Domingo because "Sowerby's species has been so much used it seems best to retain it for the fossil."

The figures of Pilsbry are as nearly identical with the California fossils as it appears necessary for them to be. Shape and size are very nearly the same. The fossils are somewhat eroded and crystallized, but it is possible to see that there were six spiral lines on the base and three near the apex of those best preserved. The apical umbilicus is wide and the angulation of the shell there is marked. The specimen illustrated herewith measures 26.1 mm. in altitude and 14 mm. in diameter. The loosening of the outer layer of the shell has produced a columellar channel which, being artificial, should be ignored in comparisons. There does not appear to be a Gulf of California living "analogue" of this West Indian form, nor has anything like it been recorded from the Isthmuses of Tuhauntepec and Panama fossil deposits. Whether present-day taxonomists would give the Mediterranean form so wide a geographic and stratigraphic range as this cannot be answered, but, accepting the work of the past, no biologic reason could be discovered in the fossils to warrant their separation.

[9] Trans. Wag. Free Inst. Vol. 3, pt. 6, 1903, p. 1583.

3. **Cancellaria obesa** Sowerby

Plate 20, figures 3, 4

Specimens examined

Locality	Collection	Number
701	C.A.S.	1
4	U.C.	1
738	U.C.	36
..	S.D.S.N.H.	5

Shape and sculpture in this series are variable, but less so than among an equal number of living shells from Magdalena Bay, Lower California. Some of the fossils are almost smooth on the body whorls, a senile character apparently, while others are heavily cancellated. Between the two forms, there is every stage of intergradation. The name, *C. urceolata* Hinds appears to have been applied to the strongly marked forms, and if this name be admitted, it should certainly be applied to some of the above fossils.

The largest of the above listed specimens (S. D. S. N. H. coll.) is 45 mm. in altitude and 23 mm. in diameter, but living specimens have been seen which considerably exceed these dimensions.

The Gatun species, *C. dariena* Toula,[10] seems to be strongly marked constantly, and differs otherwise from the Coyote Mountain fossils.

4. **Cassis subtuberosa** Hanna, new species

Plate 20, figure 8; plate 29, figures 2, 3

Shell with a single row of low, close-set tubercles around the periphery of the last half of the last whorl; spiral striation absent but last part of last whorl irregularly longitudinally ribbed; spire moderately elevated, conical; columellar face and expanded outer lip roughly triangular in shape; 11 low lamellar teeth on the outer lip; columellar face irregularly ridged in the lower part; the upper projecting angle somewhat eroded due to wear before the specimen was preserved.

The species is most closely related to *C. tuberosa* Linnæus. In addition to the type specimen two others are in the series of shells examined, but only one is of value in defining the species.

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[10] Jahr. K. K. Geol. Reich., Vol. 58, 1908, p. 703, pl. 25, fig. 13, pl. 28, fig. 2.

This is a younger individual than the type and three indistinct rows of tubercles are visible on the body whorl. This suggests *C. sulcifera* Sowerby,[11] but all three rows in that species continue to develop to maturity.

The upper projection of the enamelled columellar face is extended almost exactly in the same proportion in the younger individual of *subtuberosa* as in *C. tuberosa*. This specimen indicates that there may be intergradation between the fossils and living forms if sufficient material were at hand for study. In neither of the fossils are the tubercles massive nor do the earlier ones show in the aperture of the shell as in *C. tuberosa*.

Type and *paratype:* In the collection of the University of California from **Loc. 738, Alverson Cañon, Coyote Mountain, Imperial County, California.** Another very poorly preserved specimen is listed under locality 701 (C.A.S.). Casts of the type and paratype are Nos. 1799 and 1800 (C. A. S. coll.).

The finding of this fossil *Cassis* is believed to be the first definite record of one of the larger species of the genus on the west coast of North America, either living or fossil. So far as I am aware, none has been found in the Tertiary deposits of the West Indies or the southern states, although three species are found living there at the present time. *C. tuberosa* was not found by F. M. Anderson in any of the fossil deposits of Colombia or the Isthmus of Panama, but recent specimens were secured by him at the former place. One of these has only five tubercles on the periphery of the last whorl. Two other specimens in the California Academy of Sciences from the Bahama Islands have eight and six respectively. In every case these assume the character of blunt spines and are rather distantly separated.

5. **Cerithium incisum** Sowerby

Lampania incisa SOWERBY, Thes. Conch. Vol. 2, 1855, p. 868, fig. 152.
Cerithium incisum SOWERBY, Tryon, Man. Conch. Vol. 9, 1887, p. 142, pl. 26.

Four specimen from Loc. 682 (C.A.S.) agree with the shell which Tryon has figured under the above name. The best one is fairly well preserved, but the upper part of the spire is lacking.

[11] Quart. Journ. Geol. Soc. Lond., Vol. 6, 1849, p. 47, pl. 10, fig. 1. MAURY, Bull. Am. Paleo. No. 29, 1917, p. 110, pl. 18, figs. 1, 2, 3.

6. **Conus fergusoni** Sowerby

Plate 21, figures 6, 7

Conus fergusoni SOWERBY, Proc. Zool. Soc. Lond., 1875, p. 145, pl. 15, fig. 1.

(?)*Conus mollis* BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., 1911, p. 343, pl. 23, fig. 1 (Gatun formation, Isthmus of Panama).

A single adult and 17 young of a large cone from Loc. 738, have been referred to this living species of the Gulf of California and southward. The large one has been somewhat crushed out of shape and otherwise is imperfect, but the correctness of the identification is fairly certain. This specimen is 89.7 mm. in altitude and 52 mm. in greatest diameter. While the identity of it with the living form is advisable, there is considerable doubt as to the correct name which should be applied. *C. fergusoni* was described from a living specimen from Panama and has since been found at numerous localities on the west coast. The California Academy of Sciences' collections contain a good series. In them there are also several fine specimens from the Gatun beds of the Isthmus of Panama. They appear to be identical with the species from there which was named *C. mollis* by Brown and Pilsbry. Both series show some variation in height of spire and the sculpture between the sutures.

In the original description of *C. mollis,* comparison is made with *Conus haytensis* Sowerby,[12] a species which was described without illustration from the Santo Domingo Miocene. Maury,[13] however, figured it and remarked upon the closeness of *C. mollis* to it. If they should prove to be the same, as seems likely, *C. haytensis* will replace both names, *fergusoni* and *mollis.*

The young examples from locality 738 are all more or less imperfect and could, with equal propriety, be determined as any one of a dozen named species. Through crystallization they have lost their finer sculpture and many of them are crushed and broken. The shape does not deviate from that of *fergusoni* sufficiently to be noted herein.

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[12] Quart. Journ. Geol. Soc. Lond., Vol. 6, 1849, p. 44
[13] Bull. Am. Pal. No. 29, 1917, p. 35, pl. 5, fig. 1.

7. **Conus planiliratus** Sowerby

Conus planiliratus Sowerby, Quart. Journ. Geol. Soc. Lond., Vol. 6, 1849, p. 44—Maury, Bull. Am. Paleo. No. 29, 1917, p. 47, pl. 7, fig. 10.

At locality 738 nine small specimens of *Conus* were collected. All are imperfect, being badly crystallized and the sculpture is in no condition to warrant very definite identification. They seem to be closer to this Miocene species of West Indian and Panama deposits than to any other. In the most perfect specimen there are about 20 spiral grooves, but whether the ridges have been cut transversely, it is impossible to ascertain. The shape of the spire is about the same as that of *planiliratus* of which the California Academy of Sciences has a large series from Panama. The largest specimen from Coyote Mountain, however, is only 19 mm. in altitude and 10.5 mm. in greatest diameter.

8. **Conus regularis** Sowerby

Plate 21, figure 8

Conus regularis Sowerby, Conch. Ill. 1841, fig. 45—Dall, Proc. U. S. Nat. Mus., Vol. 38, 1910, p. 221.

Specimens examined

Locality	Collection	Number
682	C.A.S.	11
55	U.C.	4
6847	U.S.G.S.	2

The above name is applied to the Coyote Mountain fossils with the meaning attached to it given by Dall in the publication, cited above, and not as defined by Tryon.[14] Most of the above specimens show traces of bold square maculations very distinctly. In the fossils, the color of these spots is brown, in the living shells, red.

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[14] Man. Conch., Vol. 4, 1884, p. 37, pl. 11, figs. 98, 99, 100, 1, 2.

9. **Crepidula onyx** Sowerby

One specimen collected by Mr. Frank Stephens at Coyote Mountain is in the collection of the San Diego Society of Natural History. It is rugose like one figured by Tryon.[16]

10. **Crucibulum spinosum** Sowerby

Specimens examined

Locality	Collection	Number
680	C.A.S.	2
682	C.A.S.	1
51	U.C.	2
3922	U.S.G.S.	1

All of the above specimens are somewhat imperfect, but no characters could be discovered by means of which they could be distinguished from living specimens of this widespread and highly variable species.

11. **Fasciolaria princeps** Sowerby

Specimens examined

Locality	Collection	Number
56	U.C.	1
738	U.C.	1
688	C.A.S.	1
701	C.A.S.	1
3922	U.S.G.S.	1
3923	U.S.G.S.	1

The best preserved of the above specimens (Loc. 738 U.C.) are referred to *F. princeps* without hesitation. The species is found living from Magdalena Bay, Lower California, to Panama, and a considerable series has been available for comparison. It is understood that the shells of the species are almost indistinguishable from those of *F. papillosa (F. gigantea* Keiner) of the east coast, but considerable differences exist in the operculums. Under the circumstances, it seems logical to refer the fossils to the western form.

[16] Man. Conch., Vol. 8, p. 128, pl. 37, fig. 37.

12. **Ficus decussata** Wood

Plate 21, figure 9

Specimens examined

Locality	Collection	Number
55	U.C.	2
682	C.A.S.	2

One of the specimens from the last lot mentioned above is fairly well preserved; it measures 30 mm. in altitude; 22.5 mm. in diameter. The other specimens are small casts not readily determinable with certainty, but presumably the same. Even the best preserved has so crystallized that the minute sculpture cannot be discerned and apical characters have been lost. Burnett Smith[16] in treating of the morphology of the genus gave apical characters for the separation of most of the living species, but did not indicate the constancy of sculpture in a large series of shells from one locality.

East American paleontologists do not seem to have adopted the genus-name *Ficus* Bolten, in place of *Pyrula* Lamarck, as proposed by Dall[17] in 1909. Western students have generally accepted the change and their example is followed herein, without, however, giving consideration to the merits of the case.

F. decussata is the name generally used for the common species found living in the Gulf of California. A large series collected in 1921 by the Expedition from the Academy has been available for comparison and within the lot, variation in sculpture is sufficient to cover the Coyote Mountain fossils.

13. **Littorina varia** Sowerby

Two specimens from Loc. 6836 (U.S.G.S.) have been referred to this exceedingly variable species. They show no trace of spiral sculpture. The best one is figured and measures, altitude 25.5 mm.; diameter 20 mm.

The species belongs to a tropical group which is exceedingly widespread. The east coast representative is *L. scabra* Linnæus; this can scarcely be separated from *varia* with certainty.

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[16] Proc. Acad. Nat. Sci. Phila., 1907, pp. 208-219, pl. 17.
[17] U. S. Geol. Surv. Prof. Ppr. 59, 1909, p. 74.

14. **Malea ringens** Swainson

Plate 21, figure 10

Specimens examined

Locality	Collection	Number
53	U.C.	1
55	U.C.	22
56	U.C.	2
738	U.C.	3
739	U.C.	3
680	C.A.S.	3
681	C.A.S.	1
682	C.A.S.	1
701	C.A.S.	4
3919	U.S.G.S.	2
3922	U.S.G.S.	1
3923	U.S.G.S.	3
6847	U.S.G.S.	1

This large series consists of some well preserved specimens and others which are merely casts. The largest is only 75 mm. in altitude, which is small as compared with some recent specimens from the Gulf of California. The number of spiral ribs varies from 13 to 20 and there appear to be no characters for specific separation of the fossils from living specimens.

The name *M. camura* was given to a fossil from Santo Domingo in 1866[18] and Gabb[19] has stated that it is the same as *M. ringens*. As *camura,* Maury[20] has figured it from Santo Domingo, and it has been listed under that name from Gatun.[21] The two forms are certainly very close, perhaps identical.

15. **Mitra sulcata** Swainson

Two imperfect specimens from Loc. 738 (U.C.) have been referred to this species in the sense in which Tryon[22] used the name. The preserved sculpture is identical with that of living specimens from the west coast of Central America which are available for comparison.

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[18] GUPPY, Quart. Journ. Geol. Soc. London, Vol. 22, 1866, p. 287, pl. 17, fig. 9.
[19] Trans. Am. Phil. Soc., Vol. 14, 1873, p. 223.
[20] BULL. 29, Am. Paleo., 1917, p. 112, pl. 19, fig. 3.
[21] BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., 1911, p. 356.
[22] Man. Conch., Vol. 4, 1882, p. 139.

16. **Mitrularia equestris** Linnæus

Five casts of what appeared to be this species were collected on Coyote Mountain by Mr. Frank Stephens for the San Diego Society of Natural History.

17. **Modulus unidens** Lister

Three specimens from locality 6847 (U.S.G.S.) and seven from locality 682 (C.A.S.) are almost certainly referable to this variable species found living in the Gulf of California as well as on the east coast. All are crystallized so that the finer sculpture cannot be seen, but they agree with small specimens of *unidens* in shape. The margin is rather sharply carinate and the base has about five spiral cords. The largest specimen is five mm. in diameter. The tooth on the columella does not differ from that of living specimens from the Gulf of California.

18. **Natica unifasciata** Lamarck

Specimens examined

Locality	Collection	Number
738	U.C.	7
682	C.A.S.	2
6847	U.S.G.S.	3

These specimens appear to belong to *unifasciata* as represented in collections available from Panama northward and by fossils from the Pleistocene deposits of Magdalena Bay, Lower California. Nevertheless the identification is attended with some uncertainty due to the difficulties of determining species in the genus and the comparatively poor preservation of the Coyote Mountain fossils.

19. **Natica uber** Valenciennes

Of this species there are 15 specimens from locality 738 (U.C.), one from locality 6847 (U.S.G.S.) and four from locality 682 (C.A.S.). It is known from Pleistocene deposits of the west coast of Lower California, the Galapagos Islands

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and Payta, Peru, and lives now from the Gulf of California as far south as Callao, Peru, according to Dall.[23]

20. **Nerita scabricostata** Lamarck

A fragment of a *Nerita* 10 mm. across came from locality 738 (U. C.). Only the upper surface of the first two whorls is preserved. The sculpture of this is the same as of *N. scabricostata*, a living species found from the Gulf of California to Panama.

21. **Neritina picta** Sowerby

Eleven specimens of this species came from locality 6847 (U.S.G.S.) and 77 from locality 682 (C.A.S.). This large number shows, as usual in the species, considerable variation in form. In many of them the color is preserved and corresponds fairly well with that of living *N. picta* from the Gulf of California and southward.

22. **Oliva spicata** Bolten

Plate 21, figures 4, 5

Specimens examined

Locality	Collection	Number
6847	U.S.G.S.	5
738	U.C.	70
682	C.A.S.	8
..	S.D.S.N.H.	9

This large series contains no variations which are not found in a series of recent specimens of equal size from the Gulf of California. The form named *angulata* by Lamarck does not seem to be entitled to even subspecific rank because it is found with typical *spicata* and there appears to be perfect intergradation between the two. This is true of the fossils as well as the recent specimens.

The east coast analogue of this species is *O. reticularis* Lamarck. It likewise is subject to considerable, but less variation and in a large series intergradation with *spicata* is

[23] Proc. U. S. Nat. Mus., Vol. 37, 1910, p. 235.

thorough, particularly when the fossils are considered. Since the latter name has precedence the eastern shells will probably eventually take a subspecific name.

The synonymy of North American living species of *Oliva* has been thoroughly worked out by Johnson,[24] Mazyck[25] and Vanatta.[26]

The fossil forms exhibit the great range of variation in size for which the recent species is know. The largest specimen in the collections measures 78.5 mm. in altitude and 38.3 mm. in diameter. Another broken one was 45 mm. in diameter. The large specimens show a tendency to have an angulated periphery. Johnson[27] has listed 27 specific and subspecific names which have been applied to living specimens.

23. **Olivella gracilis** Broderip and Sowerby

At Loc. 738, there was obtained a single badly broken specimen of a slender *Olivella,* having no characters distinct from the recent species of the Gulf of California.

24. **Solenosteira anomala** Reeve

Plate 20, figures 1, 2

Nine specimens which have been identified as this species came from locality 738 (U.C.). They are the same as Böse[28] listed and figured as *Melongena mengeana* Dall, from Paso Real cerca de Tuxtepec, Oaxaca deposits which he called Pliocene. The species lives on the west coast of Mexico at the present time and is found living and in Pleistocene beds at Magdalena Bay on the Pacific side of the Peninsula of Lower California. The fossils from Imperial County, California are identical with *S. anomala* as figured by Tryon[29] and represented by various specimens in the collection of the California Academy of Sciences. Tryon called the species a synonym of *Melongena pallida* (Brod. & Sowby.), but the differences

[24] Nautilus, Vol. 24, 1910-11, pp. 49, 64, and 121; Nautilus, Vol. 28, 1915, pp. 97 and 114.
[25] Nautilus, Vol. 28, 1915, p. 139.
[26] Nautilus, Vol. 29, 1915, p. 67.
[27] Naut., Vol. 28, 1915, p. 115.
[28] Bull. Inst. Geol. Mex. No. 22, 1906, p. 40, pl. 4, figs. 25, 26.
[29] Man. Conch., Vol. 3, 1881, p. 109, pl. 42, figs. 212, 213.

seem sufficiently great to be recognized. It is true, however, that several allied species of the group form an intergrading series.

25. **Strombus galeatus** Swainson

Specimens examined

Locality	Collection	Number
738	U.C.	2
680	C.A.S.	2
682	C.A.S.	2
701	C.A.S.	2
3923	U.S.G.S.	2

Most of these specimens have weathered out as internal casts, but size and shape are so nearly identical with living ones of this abundant Gulf of California species that they are unhesitatingly classed as the same.

26. **Strombus gracilior** Sowerby

Four specimens, some of which are well preserved, have come from localities 682 and 701. They do not differ in any noteworthy feature from recent and fossil shells in the collection from Magdalena Bay, Lower California, and a very large series collected in the Gulf in 1921 by Dr. Fred Baker.

27. **Strombus obliteratus** Hanna, new species

Plate 20, figure 7

Shell similar to *Strombus granulatus* Gray but shorter and stouter; a row of prominent spines situated on the shoulder of all the whorls; this is succeeded on the body whorl by another row, below; although these are smaller than the shoulder row, they are much more pronounced than the middle row of nodules on the body whorl of *S. granulatus*.[30] The third and lowermost row of nodules on the latter is replaced in *S. obliteratus* by a spiral ridge; between this and the rows of spines, there is no indication of spiral sculpture which is so pronounced in the recent species; no granulation is present on the

[30] Tryon, Man. Conch., Vol. 7, 1885, p. 110, pl. 3, fig. 2.

inside of the outer apertural margin in the type or any of the other specimens which are well enough preserved to show it. Altitude 61 mm.; diameter, 45 mm.

Type: No. 1809, Mus. Calif. Acad. Sci., from Loc. 682, **Alverson Cañon, Coyote Mountain, Imperial County, California**; G. D. Hanna, coll.

Specimens examined

Locality	Collection	Number
680	C.A.S.	1
682	C.A.S.	6
701	C.A.S.	17
738, 53, 55,56	U.C.	5
6847	U.S.G.S.	3
..	S.D.S.N.H.	1

While having undoubted close relationship with *S. granulatus* this species does not appear to intergrade with it in the important characters mentioned.

28. **Terebra gausapata** Brown & Pilsbry

Plate 22, figures 4, 5

One specimen was found at Loc. 738 (U.C.). It is very well preserved as shown by the figure herewith. Its identity with the species described by Brown & Pilsbry[31] is not doubted. Of that species there are four specimens from Gatun in the California Academy of Sciences and some of them do not differ appreciably from the one from Imperial County, California. Brown & Pilsbry apparently had but a single specimen upon which to base their original description and therefore were unable to make any statement as to the variation or the relationship of the species. Attention is therefore called to the fact that the spiral striation which they mention as being present on the sutural band can scarcely be discerned in some specimens while in others it is very plain. The number of ribs on each whorl varies from 14 to 18 in specimens from Gatun and the one from southern California has 20. Spiral threads below the sutural band vary in number from three to five.

[31] Proc. Acad. Nat. Sci. Phila., 1911, p. 340, pl. 22, figs. 8, 9.

Some specimens of *T. pedroana* Dall have convex spires like *T. gausapata,* but they are rare and differ in sculpture. So far as a large series of the former show, the two species cannot be connected by a series of intergrades. The fossils seem closer to the east coast Pliocene and recent species, *T. dislocata* (Say) than to the west coast form. *T. martini* English, from the Fernando Pliocene of California is a shell similar in size to *gausapata* but the vertical ribbing is much more pronounced in most specimens and the spiral lines are obsolete or nearly so.

29. **Terebra protexta** Conrad

Terebra protexta CONRAD, Proc. Acad. Nat. Sci. Phila., Vol. 3, 1843, p. 26—TRYON, Man. Conch., Vol. 7, 1885, p. 25, pl. 6, fig. 98.

A single poorly preserved specimen of a *Terebra* was secured at Loc. 682 (C.A.S.) which has the very fine ribbing of this common species of Florida. There is no species known from the west coast of America at the present time which appears to approach this condition. The specimen did not exceed 10 mm. in length when it was perfect.

30. **Turris albida(?)** Perry

Specimens examined

Locality	Collection	Number
738	U.C.	6
6847	U.S.G.S.	1

The last measures 34.5 mm. in length and 19 mm. in width. If *T. albida* includes all of the variations which Dall[82] and Maury[83] attribute to it then certainly it must include the specimens from Imperial County, California. Of the numerous variations the latter resembles most the one figured by Maury[84] as *T. a. barretti* (Guppy)[85] from the Miocene of Jamaica. The range of the species is given as from the Oligocene of Vicksburg, Mississippi, through the various Tertiary horizons of the West Indies, Florida and the Isthmus of Panama to the Recent. A large series of fossils from Gatun shows no such

[82] Trans. Wag. Inst., Vol. 3, 1890, pt. 1, p. 28, pl. 4, fig. 8a.
[83] Bull. 29, Am. Paleo., 1917, p. 214, pl. 8, figs. 4-8.
[84] op. cit. fig. 5.
[85] Quart. Journ. Geol. Soc. London, Vol. 22, 1866, p. 290, pl. 17, fig. 6.

range of variation as Maury has figured, and they have more numerous ribs and are nearer uniform in size than the specimens from California. If these latter were not imperfect, it would be possible to say definitely whether they were the same, but they all lack canals, and, moreover, the shell substance is crystallized so that the finer sculpture is obliterated. No west coast species is known with which comparison can be made.

31. **Turritella imperialis** Hanna, new species

Plate 21, figures 1, 2, 3

Shell robust, slender, apical angle from 10° to 12°; suture well impressed; whorls deeply constricted in the middle, thus forming spiral ridges, the upper of which is slightly the larger; each ridge slopes gently to the center and to the suture; both are indistinctly noded in the type specimen; in others nodes are much more evident; between the two ridges there are four faint spiral threads in the type; in some specimens these are scarcely visible and in others they are stronger, varying in number from two to six; aperture circular with the exception of the deep constriction between the two ridges.

Type: In the Univ. Calif. Coll. from Loc. 738 (U. C.) **Coyote Mountain, Imperial County, California**; collected by W. S. W. Kew. A cast of the type is preserved as No. 1811, Mus. Calif. Acad. Sci. collection of type material.

The type specimen is 55 mm. long and 25 mm. in diameter. The entire length of this specimen was about 125 mm.

Specimens examined

Locality	Collection	Number
738	U.C.	62
6847	U.S.G.S.	3
680	C.A.S.	1
681	C.A.S.	6
682	C.A.S.	4
683	C.A.S.	3
685	C.A.S.	8
688	C.A.S.	1
701	C.A.S.	4

This species undoubtedly belongs to a group which attained maximum development in the Miocene and Pliocene of the east coast from Maryland to the West Indies. Variation among them has been so great that many names have been applied. Dall[36] has stated that these . . . "will probably be diminished when sufficient material has been brought together and carefully studied." On actual comparison of the western shells with Miocene material from the Chipola Marls of Florida some specimens of the latter are found which approach very closely. These I take to be *T. terebriformis* Dall,[37] an unfigured species. The only observable difference which appears to be constant is the lack of nodes on the spiral ridges. Size, shape and other sculpture appear to be identical.

The representative of the group in the Gatun formation of Panama is *T. altilira* Conrad,[38] the spiral ridges of which are high, and very decidedly crenulated. In no instance is intergradation with the California specimens approached.

Another closely related Miocene species is *T. tornata* Guppy[39] of Santo Domingo. The ridges on that species also are beaded and it appears never to reach such a large size as the others which have been mentioned.

From the Pliocene of Florida comes the large species, *T. perattenuata* Heilprin[40] which belongs to the same group but appears to differ from the southern California species to a greater extent. In it there is a greater tendency to accessory spiral ribs, some of them almost equaling in strength the two major ones.

Species of undoubted alliance are not lacking in present seas although none of them appears to reach the large size of the fossils. Thus *T. exoleta* Linnæus of the Gulf of Mexico and *T. cooperi* Carpenter of the west coast are similar in general form although both appear to be constantly different. The spiral ridges are much less heavy but they remain just two in number. The latter species has been found in Pliocene deposits of Lower California, as well as living.[41]

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[36] Trans. Wag. Free Inst., Vol. 3, pt. 2, 1892, p. 316.

[37] op. cit. p. 311.

[38] For a full discussion of this species see BROWN & PILSBRY, Proc. Acad. Nat. Sci. Phila., 1911, p. 358.

[39] See Maury. Bull. Am. Paleo. No. 29, 1917, p. 294, pl. 48, fig. 15.

[40] Trans. Wag. Free Inst., Vol. 1, 1887, p. 88, pl. 8, fig. 13—DALL, opt. cit., Vol. 3, pt. 2, 1892, p. 316, pl. 16, figs. 5, 9.

[41] See DALL, Trans. Wag. Free Inst., Vol. 3, 1892, pt. 2, p. 316—TRYON, Man. Conch., Vol. 8, 1886, p. 200, pl. 61, fig. 61.

There is another living species, a single specimen of which was dredged near the mouth of the Gulf of California, *T. mariana* Dall[42] which appears from the figure to belong to the same group.

32. **Vasum cæstum** Broderip

Specimens examined

Locality	Collection	Number
6847	U.S.G.S.	1
680	C.A.S.	1
682	C.A.S.	1
..	S.D.S.N.H.	1

This species has been recorded living from Mazatlan, Mexico, by Carpenter[43] and from San Diego, California by Dall.[44] Several conchologists, including Tryon,[45] have considered it identical with the east coast living species, *V. muricatum* (Born) and it is possible that if there were good series including fossils from both sides, available for study, no differences of a constant character could be found. I have had no living specimens from the west coast for comparison, but the only difference between the fossils and living east coast material seems to be in the weaker spirals of the former. The specimen from the San Diego Society of Natural History shows only a ridge for the anterior row of spines. It is badly broken but measures 93 mm. in altitude and 83 mm. in diameter. The U. S. Geological Survey specimen has a single row of spines. And the young example from locality 682 (Calif. Acad. Sci.) has a row of spines with a ridge below. The columellar plaits number either four or five. With a large series of living and Pleistocene shells from the east coast of Colombia available for comparison, it does not seem that there are specific differences between them and the California fossils, but the problem must remain open until living specimens from the west coast can be obtained.

The status of the fossil species, *V. haitensis* (Sowerby),[46]

[42] Bull. Mus. Comp. Zool., Vol. 43, 1908, No. 6, p. 327, pl. 11, fig. 14.
[43] Maz. Cat., p. 456, 1857.
[44] Proc. U. S. Nat. Mus., Vol. 37, 1910, p. 211.
[45] Man. Conch., Vol. 4, 1882, p. 71.
[46] Quart. Journ. Geol. Soc. London, Vol. 6, 1849, p. 50, Vol. 32, 1876, p. 523, pl. 29, fig. 3.

and *V. h. engonatum* Dall,[47] from the Florida and West Indian Tertiary deposits, has not been investigated in this connection. Maury[48] considered the two very close but did not pass upon the near identity of the fossils with living shells.

33. **Vermicularia eburnea** Reeve

This is the only member of the family Vermetidæ which has been found in the Imperial County deposits. Six specimens have come from locality 682 (C.A.S.). Some of them are fairly well preserved and agree with specimens found living at San Diego, California, and in the Gulf.

PELECYPODA

34. **Anomia subcostata** Conrad

Plate 23, figures 3, 4, 5

Specimens examined

Locality	Collection	Number
51	U.C.	19
55	U.C.	2
3919	U.S.G.S.	4
3922	U.S.G.S.	6
6836	U.S.G.S.	3
684	C.A.S.	39
687	C.A.S.	9
690	C.A.S.	11
701	C.A.S.	7

Among this large number there is exhibited great variation in shape, sculpture and weight. The radial sculpture ranges from very decided ribs to none at all and a separation into two species with this character as a basis would be valueless.

The name given above is used because Conrad's type came from Carrizo Creek, and he described and figured the shell so that it can be recognized, but it is quite possible that these fossils are not separable from some of the recent species which have earlier names.

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[47] Trans. Wag. Free Inst. Sci., Vol. 3, pt. 1, 1890, p. 100.
[48] Bull. Am. Pal. No. 29, 1917, p. 84.

ARCIDÆ

Most collectors have obtained numerous specimens of arcas in the Coyote Mountain deposits and vicinity, but the preservation has been so poor that specific identification cannot well be attempted. Most of these have been casts; in the few cases where the shell substance is preserved, it is so badly crystallized that external sculpture is largely obliterated.

35. **Atrina stephensi** Hanna, new species

Plate 27, figures 3, 4

Shell robust, inflated, beaks acutely pointed; both margins concave toward beaks; growth ridges rough but not scaled or spinose; radial ridges on posterior two-thirds of shell; these are wavy in cross section, but not spinose; byssal area flat, the opening 3.5 mm. wide; valves gape broadly. Length 200 mm.; thickness, 60 mm.; width, 112 mm.

Type: Preserved in the Museum of the San Diego Society of Natural History; *plastotype,* No. 1816, Calif. Acad. Sci. from **Coyote Mountain, Imperial County, California**; Chas. H. Sternberg, coll.

This species appears to be more closely related to *A. oldroydi* than any other; comparison has been made with the type of that species in Stanford University and it is found to have a convex swelling on the ventral margin; the radial ridges do not extend on the ventral half of the shell and the byssal area is not so flattened.

The type only has been collected; but numerous specimens of what appeared to be the same were seen by the writer embedded in an overhanging cliff on the north side of Coyote Mountain where they could not be reached.

This species is named for Mr. Frank Stephens, veteran naturalist and collector of San Diego, Calif.

36. Barnea costata Linnæus

Plate 28, figures 5, 6

Specimens examined

Locality	Collection	Number
701	C.A.S.	2
51	U.C.	5
6847 (324575 U.S.N.M.)	U.S.G.S.	1

The specimen figured is 58.5 mm. long and 20.7 mm. high. The others are but little if any larger. All are internal casts and well preserved, but dorsal plates are lacking. Regarding the identification of the specimens with the common east coast species, it should be said that they correspond exactly in shape, number of ribs and form of sculpturing on the inside of the shells. The species is found living on the east coast from Massachusetts south to Brazil and fossils date back to the Pliocene according to Dall.[49] The Miocene species of the east coast differs little from it. The use of the generic name *Barnea* Risso, instead of *Pholas* Linnæus, is in accordance with the definition of the genus as given by Dall.

In addition to some peculiar borings found in the coral heads in Alverson Cañon, Coyote Mountain, the California Academy of Sciences' Collection (Loc. 701) contains four specimens which are distinctly the work of Lithophaga or Pholadidea. The holes have been made in massive marble, subsequently filled with fine sediment and solidified. No remnants of the shells remain. They came from the collection of the California State Mining Bureau and may represent some such specimens as those photographed by Merrill[49a] and published in 1914.

CARDIIDÆ

The various collections contain numerous casts of at least three species of the genus *Cardium*. They resemble, in shape, living species of the Gulf of California, but without external sculpture positive identification would not be safe.

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[49] Trans. Wag. Free Inst. Sci., Vol. 3, pt. 4, 1898, p. 816.
[49a] Merrill, F. I. H. Mineral Resources of San Diego and Imperial Counties [California]. Calif. St. Min. Bur. 14th Ann. Rept., for 1913-1914 [1916], p. 735; advance copy Dec. 1914.

37. **Chama frondosa** Broderip

In the coral reef of Alverson Cañon, locality 681 (Calif. Acad. Sci.) 13 specimens of this species were secured. The maximum size is about 70 mm. by 50 mm. which is considered small. Exteriorly the shell substance has been greatly bored by other organisms and incrusted with bryozoa and worms. The limestone matrix adheres very tenaciously to both the inside and outside of the shells. The species has been recorded in the Gulf of California as far north as Guaymas,[50] and Dall[51] gives its range as extending from San Diego, California, to Peru.

38. **Codakia colpoica** Dall

Specimens examined

Locality	Collection	Number
3922	U.S.G.S.	3
6847	U.S.G.S.	3
680	C.A.S.	2
682	C.A.S.	6

All of the above are more or less imperfect and the valves are firmly united so that the hinges cannot be seen. In shape and sculpture they agree perfectly with specimens from the Gulf of California.

This is the species which was formerly called *C. tigerina* by Carpenter and others. Dall,[52] however, pointed out the differences between the west and east coast forms in his "Synopsis of the Lucinacea" and described the one from the Gulf of California as new.

39. **Crassitellites subgibbosus** Hanna, new species

Plate 28, figures 1, 2, 3, 4

Shell similar to *C. gibbosus* Sowerby but less swollen, and in specimens of the same size, the posterior end is longer and less up-turned. Surface roughened by growth ridges of unequal strength; umbones with three heavy undulations; hinge area and teeth similar to *gibbosus* as figured by Nelson[53] except

[50] Carpenter, Catalog Mazatlan Shells, 1857, p. 89.
[51] Bull. 112, U. S. Nat. Mus., 1912, p. 33.
[52] Proc. U. S. Nat. Mus., Vol. 23, 1901, p. 821, pl. 41, fig. 4.
[53] Trans. Conn. Acad. Arts and Sci., Vol. 2, pt. 1, 1870, p. 203, pl. 7, fig. 9.

that the central cardinal of the right valve of our species has a side brace, or spur projecting into the resilium; also in *subgibbosus* there does not appear to be the crenulation between the first and second cardinals of the right valve which he showed. Length, 55 mm.; height, 41 mm.; thickness, 29 mm. (Type.)

Type: No. 1818, Mus. Calif. Acad. Sci., from Loc. 682, **Coyote Mountain, Imperial County, California**; G. D. Hanna, coll. *Paratype:* In Univ. Calif. Coll. from Loc. 738 (U. C.). Cast of same, No. 1819, Calif. Acad. Sci.

"*Crassitella gibbosa*" was described by Sowerby[54] from Middle America and illustrated by Reeve.[55] Its range is given by Dall[56] as extending from the Gulf of California to Paita, Peru. While no specimens of the species have been available for comparison, no fossils from Imperial County have been found which agree with the two figures to which reference has been made. Reeve's figure shows a specimen with a slightly up-turned posterior extremity and the ventral margin has a compound curve toward that end. Our specimens do not appear to have such a curve. The ventral margin of *gibbosus* appears much more convex than *subgibbosus.*

Comparison need hardly be made with the fossil species of Panama, Costa Rica and the Isthmus of Darien, *C. reevei* Gabb and *C. mediamericanus* Brown and Pilsbry. Both of them have regular ribbing on the surface, concentric with the growth lines.

The material available has been 10 specimens from locality 738 (U.C.), two from locality 3923 (U.S.G.S.) and 13 from locality 682 (C.A.S.).

40. **Divaricella eburnea** Reeve

Plate 26, figures 8, 9

Specimens examined

Locality	Collection	Number
738	U.C.	10
682	C.A.S.	8
6847	U.S.G.S.	4

[54] Proc. Zool. Soc., Vol. 2, 1832, p. 56.
[55] Con. Icon. Crassitella, 1843, pl. 1, fig 1.
[56] Proc. U. S. Nat. Mus., Vol. 37, 1910, p. 260.

Except for the slightly coarser sculpture, these specimens do not differ from some from the Galapagos Islands; others found in the Pleistocene deposits at Magdalena Bay, Lower California, appear identical; the same is true of many shells from the Gulf of California. Preservation of the Coyote Mountain fossils is not good and the valves are associated so firmly that hinges could not be examined.

41. **Dosinia dunkeri** Philippi

Specimens examined

Locality	Collection	Number
738	U.C.	12
682	C.A.S.	1
3919	U.S.G.S.	2
3923	U.S.G.S.	1

The best preserved of the above specimens is figured. It measures: length 68.2 mm.; height, 71 mm.; thickness (one valve) 18.1 mm. The state of preservation is such that they cannot be satisfactorily separated from *dunkeri,* a species found living from Panama north to the head of the Gulf of California.

42. **Echinochama californica** Dall

Echinochama californica, DALL, Trans. Wagner Free Inst. Sci., Vol. 3, pt. 4, 1903, p. 1404.

Specimens examined

Locality	Collection	Number
682	C.A.S.	1
3923	U.S.G.S.	2

The above specimens from Coyote Mountain are not perfectly preserved but there is little doubt that they belong to the species *californica,* from Lower California.

The east American analogues are *E. arcinella* Linnæus, a living form, and *E. antiquata* Dall from various fossil horizons dating back to the Miocene. All form a group of closely related species, the separation of which has not been very satisfactory.

43. **Glycymeris gigantea** Reeve

Of this large species there are five specimens from Loc. 738 (U.C.) collected by W. S. W. Kew. No other collector seems to have met with it in that region. Comparison has been made with living specimens from the Gulf of California as well as with Reeve's description and figure and no differences of apparent consequence could be detected.

44. **Cyathodonta undulata** Conrad

Specimens examined

Locality	Collection	Number
4	U.C.	1
681	C.A.S.	1
3923	U.S.G.S.	1

These are casts and are somewhat smaller and thinner than living specimens from San Diego, California, supposed to be *C. dubiosa* Dall,[57] an unfigured species. In describing *C. undulata,* Conrad[57a] gave no definite locality, but Dr. Dall has stated that it is found at Lapaz and other places in the Gulf of California.

45. **Lucina edentuloides** Verrill

Lucina edentuoides VERRILL, DALL, Proc. U. S. Nat. Mus., Vol. 23, 1901, p. 802.

Specimens examined

Locality	Collection	Number
738	U.C.	1
680	C.A.S.	1
681	C.A.S.	5
683	C.A.S.	4
701	C.A.S.	25
6847	U.S.G.S.	3

Of this species there are numerous specimens in the various collections, all of which, it appears, were collected from a hill slope on the west side of Alverson Cañon, Coyote Mountain. At a point where the coral reef crosses the stream bed these shells are weathered out and can be had in considerable num-

[57] Proc. U. S. Nat. Mus., Vol. 49, 1916, p. 445.
[57a] Proc. Acad. Nat. Sci. Phila., Vol. 4, 1849, p. 155.

bers. In every case seen they were crystallized and the valves were fastened together so that the hinge structure could not be ascertained. The shape, however, coincides with that of living specimens found from Magdalena Bay, Lower California, southward. The beaks of this species are more centrally placed than in the one of the West Indies.

46. **Metis excavata** Sowerby

Plate 23, figure 6

One specimen in an excellent state of preservation was secured by Kew and English at locality 738 (Univ. Calif.). It is 47.5 mm. from the beak to the ventral margin and does not differ in any noticeable character from specimens found in the Gulf of California living at the present time.

47. **Ostrea heermanni** Conrad

Plate 22, figures 7, 8; plate 23, figures 1, 2

Ostrea heermanni Conrad, Proc. Acad. Nat. Sci. Phila., 1855, p. 267—Conrad, House Ex. Doc. 129, 33rd Cong. 1st Sess., 1855, p. 15—Conrad, Pac. R. R. Repts., Vol. 5, 1857, p. 325.

"Very irregular in form, thick, ovate and often dilated; lower valve shallow; exterior very irregular, with large distant angular radiating ribs and with pits, irregular cavities; cartilage pit broad and oblique; upper valve flat or concave, with a profoundly irregular surface. Length, 5.75 inches; height, 6.5 inches." (Original description.)

Although this species has not been previously figured, so far as I have been able to determine, there is no mistaking the fact that Conrad had specimens of the only large circular oyster of the Coyote Mountain region. It is excessively abundant in many places and also excessively variable. Uneroded specimens, however, show clearly that it is an irregularly ribbed species. The two specimens figured herewith show the characters well. Blake stated in a footnote to Conrad's description that although Dr. Heermann picked up the original specimens from the bed of Carrizo Creek, there was no doubt but that they came from the formation near at hand. I saw some examples in the cliffs of Alverson Cañon that were fully a foot in diameter.

48. **Ostrea iridescens** Gray

Plate 26, figures 4, 5, 6, 7

There are a few scattered beds of this fine species about Coyote Mountain where the shells occur in characteristic abundance on the surface. At localities 689 and 692 (C.A.S.) there were secured four and 15 respectively. These do not differ from recent specimens of the Gulf of California which are characterized by the arrangement of the shell substance in comparatively flat and regular layers. *O. chilensis* Philippi, the western representative of *O. virginica* Gmelin according to Dall,[59] has the layers irregular and often somewhat crenulated. *O. iridescens* was first adequately described by Carpenter in 1857.[60]

49. **Ostrea vespertina** Conrad

Plate 26, figures 1, 2, 3

Specimens examined

Locality	Collection	Number
3919	U.S.G.S.	2
3921	U.S.G.S.	12
3922	U.S.G.S.	7
3923	U.S.G.S.	4
6836	U.S.G.S.	5
6847	U.S.G.S.	1 (=324, 601 U.S.N.M.)
324602	U.S.N.M.	1
738	U.C.	6 (=55 W.S.W.Kew)
....	U.C.	8 (=51 W.S.W.Kew)
....	U.C.	1 (=53 W.S.W.Kew)
3003	U.C.	2
Unnumbered	....	8
681	C.A.S.	5
682	C.A.S.	3
683	C.A.S.	15
684	C.A.S.	11
690	C.A.S.	3
691	C.A.S.	5
694	C.A.S.	2
701	C.A.S.	6

[59] Nautilus, Vol. 28, p. 3, 1914.
[60] Cat. Mazatlan Shells, 1857, p. 157.

When the above list was made out, it was believed to be best to unite all the plicate oysters of the Coyote Mountain region under one name. Sufficient comparative material was lacking for a logical separation of species. Therefore the collections listed from the U. S. Geological Survey and the University of California contain some specimens of *O. heermanni* as well as *O. vespertina.*

Since the list was made and the collections returned, a large amount of comparative material, living and fossil from the Gulf of California region has been obtained, and it is believed that a separation into two species can be made with reasonable certainty, the large one taking the name *O. heermanni.*

Ostrea vespertina was first described from San Diego (Conrad, Journ. Phila. Acad. Sci.) in 1853, but was not figured until Conrad considered the specimens obtained by Blake from the Colorado desert where Carrizo Creek flows out of the Laguna Mountains upon the valley floor. Subsequent collecting at San Diego by many experienced workers has resulted in obtaining but one plicate oyster and that is the one described by Gabb[61] from Cedros Island as *O. veatchii.* That the latter is synonymous with *vespertina* can scarcely be questioned. The identity was pointed out by Dall in 1898[62] and concurred in by Arnold in 1909.[63] The former considered both names as well as *O. heermanni* Conrad, the equivalent of *O. haitensis* Sowerby, 1850, an east American species. The later views of Dall regarding the living species of western oysters are set forth in a little paper published in 1914.[64] Here we find *O. veatchii* given the status of a species.

Whether the Carrizo Creek and Coyote Mountain oysters called *vespertina* are the same as San Diego specimens originally given that name cannot be stated with certainty, but seems probable. Around the flanks of Coyote Mountain the shells form great reefs, thoroughly consolidated and cemented, in some places already partially converted to marble. Such metamorphism is unusual for such late deposits in western North America.

[61] Geol. Surv. Calif. Pal., Vol. 2, 1869, p. 35, pl. 11, fig. 61.
[62] Trans. Wagner Free Inst. Sci., Vol. 3, pt. 4, 1898, p. 686.
[63] U. S. Geol. Surv. Bull. 396, 1909, p. 78.
[64] Nautilus, Vol. 28, 1914, p. 3.

50. **Panope generosa** Gould

Specimens examined

Locality	Collection	Number
738	U.C.	4
3923	U.S.G.S.	1
682	C.A.S.	1
688	C.A.S.	1
701	C.A.S.	2

As usual with this species, a considerable amount of variation is shown in the series. The specimen from Locality 3923 (U.S.G.S.) is particularly attenuated anteriorly, but not more so than some living shells.

51. **Pecten carrizoensis** Arnold

Pecten carrizoensis ARNOLD, U. S. Geol. Surv. Prof. Pap. 47, 1906, p. 59, pl. 4, figs. 1, 1a, 1b, 2, 3, 3a.

Specimens examined

Locality	Collection	Number
3922	U.S.G.S.	1
6847	U.S.G.S.	2 (Numbered 324, 575, U.S.N.M.)
738	U.C.	9
680	C.A.S.	6
682	C.A.S.	7

The original specimens of this species came from the vicinity of Coyote Mountain and the most perfect among the above is a juvenile 31.8 mm. in diameter. *P. stearnsii* Dall, *P. diegensis* Dall and this species form a group of flat sided pectens which are much alike. *P. stearnsii* has the greatest number of ribs and each one is divided by a longitudinal sulcus. *P. carrizoensis* has the least number of ribs (about 20) and they are more rounded (less square) than in either of the other species.

52. **Pecten deserti** Conrad

Plate 25, figures 1, 2, 3

This species was originally described from specimens collected in the region by Blake and, being common, is very well known. The various collections studied have contained a great

many specimens of it. The species is most common in the hard "oyster reefs" of the uppermost beds exposed. Some places these beds are consolidated into firm rock; again they have disintegrated and the desert floor then becomes carpeted with the shells of *Pecten deserti, Ostrea vespertina* and *Anomia subcostata.* They thus become scattered far and wide.

53. **Pecten keepi** Arnold

Specimens examined

Locality	Collection	Number
3922	U.S.G.S.	2
3923	U.S.G.S.	2
6847	U.S.G.S.	4
324, 562	U.S.N.M.	1
738	U.C.	3
739	U.C.	2
680	C.A.S.	7
681	C.A.S.	7
682	C.A.S.	2
683	C.A.S.	1
687	C.A.S.	1
688	C.A.S.	1
701	C.A.S.	4

The species was described from these deposits and seems to have no close living relative on the Pacific coast, but belongs with *P. ziczag* Linnæus of the West Indies and *P. mortoni* Ravenel[65] of various east coast fossil deposits.

It is one of the most common species in the Coyote Mountain region. Specimens were seen in the black limestone which caps a southern slope of the mountain east of Alverson Cañon where the matrix was so hard that the shells could not be extracted, and the stone rang like tempered steel when struck with a hammer. No specimens were seen higher up in the sequence of strata than that, but from there downward to the basal exposure (the coral reef in Alverson Cañon) the shells were everywhere in evidence.

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[65] Böse, Inst. Geol. Mex. Bull. 22, p. 24, pl. 1, figs. 3, 6, 9, pl. 8, pl. 9, fig. 3.

54. **Pecten mediacostatus** Hanna, new species

Plate 22, figure 6; plate 24, figure 2

Shell small, altitude a little greater than length, equilateral and equivalve, not noticeably inflated. Surface sculptured with 23 (in the type specimen) ribs which are regularly rounded and are largest in the center of the valve. These ribs are strong at the ventral margin of the shell but are scarcely visible within 18 mm. of the beak; interspaces occupied by riblets, one to each, about one-third the size of the major ribs; in the better preserved specimens there is a fine even concentric sculpture of lirulæ looped over the ribs, appearing as though cut with an engraving tool; anterior ear marked with five (in cotype) radiating riblets while the posterior (in the type) is smooth except for fine even concentric sculpture. Measurements of type specimen, a single right valve, altitude 37.2 mm.; length 30 mm. (slightly compressed longitudinally); thickness 8.5 mm.

Type: No. 1830, Mus. Calif. Acad. Sci. from Loc. 681 (C. A. S.) **Alverson Cañon on the south side of Coyote Mountain, Imperial County, California,** in the Pliocene coral reef about midway up the cañon.

There is only one west coast species with which the sculpture of this can be compared, *Pecten estrellanus* (Conrad) of Miocene and lower Pliocene strata. That species is more inflated, longer than high, and the ribs extend entirely to the beak; moreover, the ribs are squarish and interspaces channeled on each side of the smaller riblet.

Twenty-seven specimens were obtained from the coral reef of Alverson Cañon, Loc. 681, and one from Loc. 683, both of the California Academy of Sciences' series. The reef is a well-marked feature of the topography as one ascends the cañon, yet it does not appear to have been explored heretofore, since none of the numerous collections seen has contained this species. Like *P. sancto-ludovici* the specimens are more or less poorly preserved and usually somewhat crushed out of shape.

55. **Pecten mendenhalli** Arnold

Plate 25, figures 4, 5

Specimens examined

Locality	Collection	Number
3922	U.S.G.S.	4
3923	U.S.G.S.	13
324, 549	U.S.N.M.	1
738	U.C.	10
2064	U.C.	7
681	C.A.S.	1
701	C.A.S.	2

Shape and sculpture are as Arnold[66] has described. Each ear is consistently heavily sculptured with several ribs, but these are shown as smooth in *P. cerrosensis* Gabb.[67] The species, *circularis, deserti,* and *mendenhalli* are undoubtedly very closely related. With a large series of specimens from different places, it is possible all would be found to constitute an intergrading series, but at present some of the connecting links seem to be absent.

56. **Pecten sancti-ludovici** Anderson and Martin

Plate 22, figures 1, 2, 3

This species was described[68] from material collected "along the west side of San Juan River about one-half mile above the mouth of Navajoa Creek, Northeastern San Luis Obispo County, California," by Bruce Martin. Other specimens were taken in the near vicinity. All came from strata of the "Santa Margarita" formation or Upper Miocene. The type, a paratype, and six other specimens from the type locality, are in the California Academy of Sciences and all are beautifully preserved.

Until now the species does not appear to have been found elsewhere, but in the coral reef of Alverson Cañon, Imperial County, California, Loc. 681 (C.A.S.) 12 specimens were taken. Two additional specimens were taken at Loc. 683 (C.A.S.) and there is a crushed one from Loc. 2064 (U.C.). All are somewhat broken and crushed, but they are placed

[66] U. S. Geol. Surv. Prof. Pap. 47, 1906, p. 84, pl. 25, figs. 2, 2a, 2b.
[67] Geol. Surv. Calif. Pal., Vol. 2, 1869, pl. 9, fig. 55.
[68] Proc. Calif. Acad. Sci. 4th ser., Vol. 4, 1914, p. 55, pl. 3, figs. 10a, 10b.

with the Santa Margarita form without hesitation. Rarely are examples of any species from two localities so nearly identical.

The sculpture of the species at once recalls *hastatus* and if only the right valve were known, it could be easily taken for that. The number of ribs is about the same, likewise the serrations of the riblets; but there is no tendency in *sancti-ludovici* for the ribs to be double or in pairs. The main distinguishing feature, however, is the fact that while the left valve only of *hastatus* has about nine ribs, in *sancto-ludovici* the number is the same as in the right.

57. **Pecten subnodosus** Sowerby

Plate 25, figure 6

Specimens examined

Locality	Collection	Number
738	U.C.	6
680	C.A.S.	1
690	C.A.S	4

These specimens are not perfectly preserved, but with a large series of living and fossil shells from the Gulf of California region for comparison, there is believed to be no adequate reason to doubt the identity. None of the above specimens had so many riblets between the main ribs as have been seen in some living shells, but this is probably due to the small series; certainly some living individuals, unquestionably *subnodosus,* have as few riblets as these. As in *P. etchegoini* farther north, the strength of the nodes varies greatly in a series of shells.

58. **Phacoides xantusi** Dall

Plate 28, figure 7; plate 29, figure 1

Phacoides xantusi DALL, Nautilus, Vol. 18, 1903, p. 110.
Phacoides childreni of authors; not of Gray.

Specimens examined

Locality	Collection	Number
738	U.C	3
2064	U.C	1
3923	U.S.G.S.	3
681	C.A.S.	17

The above specimens are all more or less crystallized so that the finer sculpture is obliterated, and the valves are so firmly fastened together that the hinge structure has not been examined. This and four other species, one of the Miocene and Pliocene of California,[69] one of the east American recent fauna,[70] one east American Pliocene form,[71] and one of the Florida Miocene,[72] form a group of closely related forms. The Coyote Mountain fossils, however, seem to be most closely related to the shells found living in the Gulf of California at the present time. It has already been listed as *P. childreni* from the Pliocene of Lower California at San Juan by Dall (Op. cit. 1903).

59. **Pinna latrania** Hanna, new species

Plate 27, figure 1; text figure 1

Shell thin, long and slender, apical angle acute (27°); surface apparently unmarked externally by ridges, ribs or spines, except for a heavy longitudinal mid-rib in each valve; this is

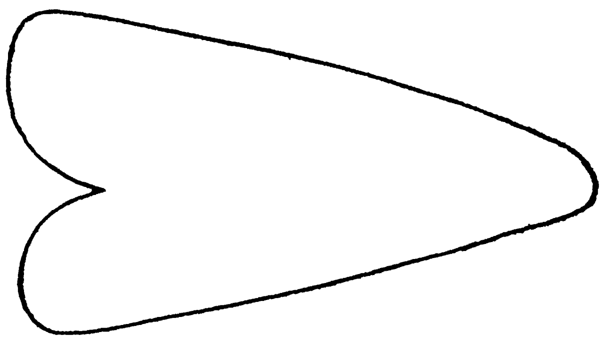

Fig. 1. Outline of *Pinna latrania*, n. sp.

rounded convex, internally and apparently sharply carinate externally and divided longitudinally, the two parts being united by cartilage; the length of this rib is unobtainable from available material, but in other species it does not extend entirely to the beak; each valve is deeply sulcate at the mid-rib

[69] *P. sanctaecrucis* Arnold, U. S. Geol. Surv. Bull. 396, 1909, p. 57, pl. 6, fig. 6.
[70] *P. childreni* Gray.
[71] *P. smithwoodwardi* Maury, Bull. 29, Am. Paleo., 1917, p. 204, pl. 35, fig. 6.
[72] *P. caloosaensis* Dall Trans. Wagner Free Inst. Sci., Vol. 3, pt. 6, 1903, pl. 28, fig. 1.

so that in looking down upon it, it is double-looped. Length of type specimen, 135 mm.; width from hinge line down, 63 mm.; gape posteriorly, 51 mm.; length of hinge line, 116 mm.; length of byssal scar, 85 mm.

Type: No. 324,593 (U. S. Nat. Mus.) from Loc. 3922 (U. S. Geol. Surv.), **Coyote Mountain, Imperial County, California.** A cast of the type is No. 1837 (C. A. S. Coll.).

The type specimen lacks both anterior and posterior ends and is largely a decorticated cast. A paratype in the Museum of the San Diego Society of Natural History was collected at the same locality by Mr. Frank Stephens. This specimen shows the shape of the posterior end of the shell. A cast of it is preserved as No. 1838 of the California Academy of Sciences.

60. **Pinna mendenhalli,** Hanna, new species

Plate 27, figure 2

Shell thick and heavy; apical angle obtuse (47°); outer surface without sculpture or distinct ribs; there is a low longitudinal ridge, however, on the ventral half of each valve; midrib exceedingly heavy (7 mm. thick in a fragment preserved on one specimen); rounded on the interior and apparently sharply carinate on the exterior. Each valve appears to be divided through this rib for at least a portion of its length because in the remnants of the shell preserved on the casts, there are ligament scars as shown in the figure. The gape extends the full length of the shell and the byssal scar appears to do the same; beak and posterior margins not seen. Greatest length of type, 167 mm.; greatest breadth, 98 mm.; thickness, 58 mm.; full dimensions were: length about 200 mm. and breadth 100 mm.; thickness of the paratype is 66 mm.

Type: No. 324,593 (U. S. Nat. Mus.) from locality 3922, (U. S. Geol. Surv.). One paratype from the same place bears the same number. Both specimens are imperfect and little better than internal casts. A cast of the type is preserved as No. 1839 (C.A.S. Coll.).

This species is unlike any other from west coast Tertiary and appears to resemble *P. caloosænsis* Dall[73] from the Florida

[73] Ter. Faun. Fla., Vol. 3, pt. 4, 1898, p. 660, pl. 26, fig. 4.

Pliocene in a general way. The resemblance, however, is only in structure and not in form because that species has an apical angle of only about 18°. It is closer to *P. latrania,* new species, from the Imperial County deposits than any other known to the writer.

The species is named for Mr. W. C. Mendenhall, who, with Dr. Stephen Bowers, collected the type material and who very kindly gave me much information relative to the occurrence of fossils.

61. **Spondylus calcifer** Carpenter

In the collections of fossils from Coyote Mountain, there are several specimens which do not appear to differ from this living species of the Gulf of California. Two are from Loc. 3923 (U.S.G.S.); one from Loc. 53 (2064) (U.C.); and one from locality 685 (C.A.S.). Not any of these, however, has reached the ponderous size which is attained by some living examples of the species. Consequently they have been compared with the young of *calcifer.* All are more or less imperfect. The best is from the first locality mentioned and it has been figured. It is seen to be very irregularly spinose; concentric sculpture is almost absent; the beak is very high and the ligamentary canal continuous to the apex.

I have seen 12 names which have been applied to west coast Spondylidæ, and there may be others. Most of these, however, have been applied to various and sundry modifications of the forms known as *pictorum* and *limbatus,* no representatives of which appear in the fossil beds at the head of the Gulf.

62. **Spondylus bostrychites** Guppy

Plate 24, figures 3, 4

Spondylus bostrychites GUPPY, Proc. Sci. Soc. Trinidad, p. 176, 1867—GABB, Geol. Santo Domingo, 1873, p. 257—DALL, Tert. Faun. Fla., Vol. 3, pt. 4, 1898, p. 758—DALL, Bull. 90, U. S. Nat. Mus., 1915, p. 124, pl. 19, fig. 4—MAURY, Bull. 29, Am. Paleo., 1917, p. 190, pl. 32, fig. 4.

This species, first described as *S. bifrons* in 1849,[74] was not figured until 1915, and then very imperfectly. No one has

[74] Sowerby, Quart. Jour. Geol. Soc. Lond., Vol. 6, 1849, p. 53.

shown the hinge area although Sowerby stated in his original description that it is "easily distinguishable by the area of one valve being very narrow and that of the other valve being rather broader, though still narrow." Both Gabb's and Guppy's mention of the species *bostrychites* are in publications which are very inaccessible and no one has thus far given a description of the species, since those authors wrote. Identification would have probably been impossible had it not been for the fact that our specimens were compared directly with Guppy's type of *bostrychites* and other material in the National Museum. This was done through the kindness of Mr. W. C. Mansfield.

Guppy's type was a young individual similar to the one Maury has figured. Dall's figure is of an older example, but neither of them shows the minute sculpture which appears to be characteristic; at any rate, it is present on the type and others.

At Loc. 738 (U.C.) and also at Loc. 685 (C.A.S.) a specimen was secured. The former is the more perfect and has been figured. The spines are arranged in five radial rows, but they have been broken away so that their length cannot be compared with those of *bostrychites*. In the intervening spaces, there are from five to nine smaller radial ridges which become slightly spinose toward the outer margin of the shell. These are irregular in size. The surface is marked by very small, wavy, concentric lines which are broken into many papillæ, particularly toward the center of the shell. The hinge area is slightly heavier than in the specimens from Santo Domingo which were compared, but this is a variable character in the genus. The ligamentary groove extends to the apex. Apex not elevated or spiral. Valves of about equal size and convexity. In the latter respect the species differs from *S. scotti* Brown & Pilsbry[76] and the larger species which they did not figure and therefore cannot be recognized.

The specimen figured, although somewhat broken, measures 86 mm. in a line parallel to the hinge, and 99 mm. high. The larger specimen measures 115 mm. by 125 mm. but it likewise is imperfect. If perfect, the latter dimension would be increased by about 10 mm.

[76] Proc. Acad. Nat. Sci. Phila., 1912, p. 514, pl. 25, figs. 1, 2.

63. **Tagelus californianus** Conrad

A single specimen of Tagelus was obtained at Loc. 6847 (U.S.G.S.). It does not differ from specimens of the above species which is exceedingly common in the Gulf of California. It measures: length, 55 mm.; height in center, 22.3 mm.; thickness as preserved, 13.5 mm.

ECHINODERMATA

64. **Clypeaster bowersi** Weaver

Specimens examined

Locality	Collection	Number
680	C.A.S.	2
682	C.A.S.	1
701	C.A.S.	2
3919	U.S.G.S.	1
3922	U.S.G.S.	2
3923	U.S.G.S.	2

This huge species was described from deposits on Coyote Mountain, and there it is very abundant. The writer does not feel competent to pass judgment upon its validity, but with probably better living material from the Gulf of California available for comparison than has heretofore been gathered together in a western museum, it seems exceedingly doubtful if the fossils are really distinct.

65. **Clypeaster deserti** Kew

Specimens examined

Locality	Collection	Number
680	C.A.S.	2
3919	U.S.G.S.	1

No living species comparable to this was collected in the Gulf of California in 1921 by the Academy and it is not known if there be one there.

66. **Encope tenuis** Kew

Specimens examined

Locality.	Collection	Number
680	C.A.S.	6
3919	U.S.G.S.	2
3922	U.S.G.S.	2

67. **Hippnoë californica** Kew

One well-preserved specimen from Loc. 3922 (U.S.G.S.) is somewhat crushed, but it is the best preserved representative of the species in existence so far as the writer knows. It certainly is better than the one which Kew used for a type and which also came from Coyote Mountain deposits.

68. **Metalia spatagus** (?) Linnæus

Plate 24, figure 1

Metalia maculosa Agassiz, Mem. Mus. Comp. Zool., Vol. 3, 1872, pp. 144, 598, pls. 21b, 26, 38.
Metalia spatagus Linnæus, Clark, Mem. Mus. Comp. Zool., Vol. 46, No. 2, p. 210.

This identification of the single specimen of spatangoid echinoderm from locality 3919 (U. S. Geol. Surv.) is attended with some doubt because of poor preservation. The specimen is small; length, 32 mm.; width, 25 mm.; height, 15.6 mm. It is so eroded that none of the markings or plates remains but resembles in shape some specimens of *Metalia spatangus* from the Gulf of California. The lateral petals of the fossil are somewhat decumbent and may be the mark of a new species, but the writer is not sufficiently acquainted with the group to venture a description on such fragmentary material. Kew has recorded no species of the group from Coyote Mountain and apparently this is the first and only specimen that has been found there. One would naturally expect such forms as *Meoma grandis*, but thus far they have not been found.

Corals

The coral fauna of the Coyote Mountain district is exceedingly interesting and has been thoroughly studied by Dr. T. W. Vaughan. No less than 12 named forms are found in the various reefs. The locality is remarkable in being the northernmost representation of the groups in west American Tertiary, Quaternary, or Recent faunas. At the present time, reef building corals are not abundant on the west coast north of

the Tres Marias Islands, although this scarcity may, in part, be due to imperfect exploration about the islands of the Gulf of California. Some fine specimens, stated to have come from there were on display at the interstate exhibition held in Mazatlan, Sonora, in 1925.

69. **Dichocœnia merriami** (Vaughan)

Favia merriami VAUGHAN, U. S. Geol. Surv. Monog. 39, 1900, p. 142, pl. 15, figs. 5, 5a-c.—NOMLAND, Univ. Calif. Publ. Geol., Vol. 9, 1916, p. 60.

Dichocœnia merriami VAUGHAN, U. S. Geol. Surv. Prof Ppr. 98, 1917, p. 370, pl. 94, figs. 1, 1a.

70. **Dichocœnia merriami crassisepta** Vaughan

Dichocœnia merriami crassisepta VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 371, pl. 94, figs. 3, 3a.

71. **Eusmilia solida** (Nomland)

Madripora solida NOMLAND, Univ. Calif. Publ. Geol., Vol. 9, 1916, p. 60.
Eusmilia carrizensis VAUGHAN, U. S. Geol. Surv. Prof. Ppr. No. 98, 1917, p. 369, pl. 95, figs. 1, 1a.

Dr. T. W. Vaughan told me on January 18, 1922, his species should be referred to the name selected by Mr. Nomland.

72. **Mæandra bowersi** (Vaughan)

Diploria bowersi VAUGHAN [nomen nudum] U. S. Geol. Surv. Prof. Ppr. 47, 1906, p. 22.

Mæandra bowersi VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 374, pl. 101, figs. 1, 1a.

73. **Porites carrizensis** Vaughan

Porites carrizensis VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 375, pl. 102, figs. 5, 5a, 5b, 6, 6a.

74. **Siderastrea californica** Vaughan

Siderastrea californica VAUGHAN [nomen nudum] U. S. Geol. Surv. Prof. Ppr. 47, 1906, p. 22.—VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 375, pl. 102, figs. 2, 2a, 3, 4.

75. **Siderastrea mendenhalli** Vaughan

Siderastrea mendenhalli VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 374, pl. 101, figs. 3, 3a, 4.

76. **Siderastrea mendenhalli minor** Vaughan

Siderastrea mendenhalli minor VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 375, pl. 102, fig. 1.

77. **Solenastrea fairbanksi** (Vaughan)

Stephanocœnia fairbanksi VAUGHAN, U. S. Geol. Surv. Monog. 39, 1900, p. 151, pl. 17, figs. 11, 11a.—VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 47, 1906, p. 22.—NOMLAND, Univ. Calif. Publ. Geol., Vol. 9, 1916, p. 60.

Plesiastrea californica VAUGHAN [nomen nudum]. U. S. Geol. Surv. Prof. Ppr. 47, 1906, p. 22.

Solenastrea fairbanksi VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 372, pl. 95, figs. 3, 3a.

78. **Solenastrea fairbanksi columnaris** (Vaughan)

Stephanocœnia fairbanksi columnaris VAUGHAN, U. S. Geol. Surv. Monog. 39, 1900, p. 151, pl. 17, figs. 10, 10a.—VAUGHAN, U. S. Geol. Survey, Prof. Ppr. 47, 1906, p. 22.—NOMLAND Univ. Calif. Publ. Geol., Vol. 9, 1916, p. 60.

Solenastrea fairbanksi columnaris VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 373, pl. 96, figs. 1, 1a.

79. **Solenastrea fairbanksi minor** Vaughan

Solenastrea fairbanksi minor VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 373, pl. 97, figs. 2, 2a-2c.

80. **Solenastrea fairbanksi normalis** Vaughan

Solenastrea fairbanksi normalis VAUGHAN, U. S. Geol. Surv. Prof. Ppr. 98, 1917, p. 373, pl. 96, figs. 2, 2a-2c, pl. 97, figs. 1, 1a.

FISHES

81. **Carcharodon arnoldi** Jordan

Plate 23, figure 7

A well-preserved tooth of this shark was found at Loc. 3922 (U.S.G.S.) (No. 324542 U.S.N.M.). A cast of it is preserved as No. 1842 (C.A.S. Coll.). The identification was made by Harold Hannibal when the paper by Dr. Jordan and him was in preparation.[76]

[76] See Bull. So Calif Acad. Sci., Vol. 22, pl. 2, July 1923, p. 55, for the record of the species in "Carrizo Creek."

Plate 20

Figs. 1, 2. *Solenosteira anomala* (Reeve). Loc. 738 (U.C. Coll.); cast of plesiotype, No. 1808 (C.A.S. Coll.).

Figs. 3, 4. *Cancellaria obesa* Sowerby. Loc. 738 (U.C. Coll.); casts of plesiotypes, Nos. 1797 and 1798 (C.A.S. Coll.).

Figs. 5, 6. *Architectonica quadriceps* (Hinds). Loc. 738 (U.C. Coll.); cast of plesiotype, No. 1795 (C.A.S. Coll.).

Fig. 7. *Strombus obliteratus* Hanna, n. sp. Type No. 1809 (C.A.S. Coll.), from Loc. 682.

Fig. 8. *Cassis subtuberosa* Hanna, n. sp. Paratype from Loc. 738 (U.C. Coll.); cast of same, No. 1800 (C.A.S. Coll.).

Fig 9. *Bullaria striata* (Bruguiére). Plesiotype, No. 1796 (C.A.S. Coll.), from Loc. 682.


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Plate 21

Figs. 1, 2, 3. *Turritella imperialis* Hanna, n. sp. Type and paratypes, Loc. 738 (U.C. Coll.); casts of same, Nos. 1811 and 1812 (C.A.S. Coll.).

Figs. 4, 5. *Oliva spicata* (Bolten). Loc. 738 (U.C. Coll.); casts of plesiotypes, Nos. 1806 and 1807 (C.A.S. Coll.).

Figs. 6, 7. *Conus fergusoni* Sowerby. Loc. 738 (U.C. Coll.); casts of plesiotypes, Nos. 1801, 1802 (C.A.S. Coll.).

Fig. 8. *Conus regularis* Sowerby. Plesiotype, No. 1803 (C.A.S. Coll.), from Loc. 682.

Fig. 9. *Ficus decussata* (Wood). Plesiotype, No. 1804 (C.A.S. Coll.), from Loc. 682.

Fig. 10. *Malea ringens* Swainson. Plesiotype, No. 1805 (C.A.S. Coll.), from Loc. 682.

March 23, 1926

Plate 22

Figs. 1, 2, 3. *Pecten sancti-ludovici* Anderson & Martin. Figs. 1, 3 from plesiotypes, Nos. 1834, 1835 (C.A.S. Coll.), from Loc. 681. Fig. 2 from plesiotype in U. C. Coll., from Loc. 55 (738).

Figs. 4, 5. *Terebra gausapata* Brown & Pilsbry. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1810 (C.A.S. Coll.).

Fig. 6. *Pecten mediacostatus* Hanna, n. sp. Paratype, No. 1831 (C.A.S. Coll.), from Loc. 681.

Figs. 7, 8. *Ostrea heermanni* Conrad. Plesiotype, No. 1825 (C.A S. Coll.), from Loc. 693.

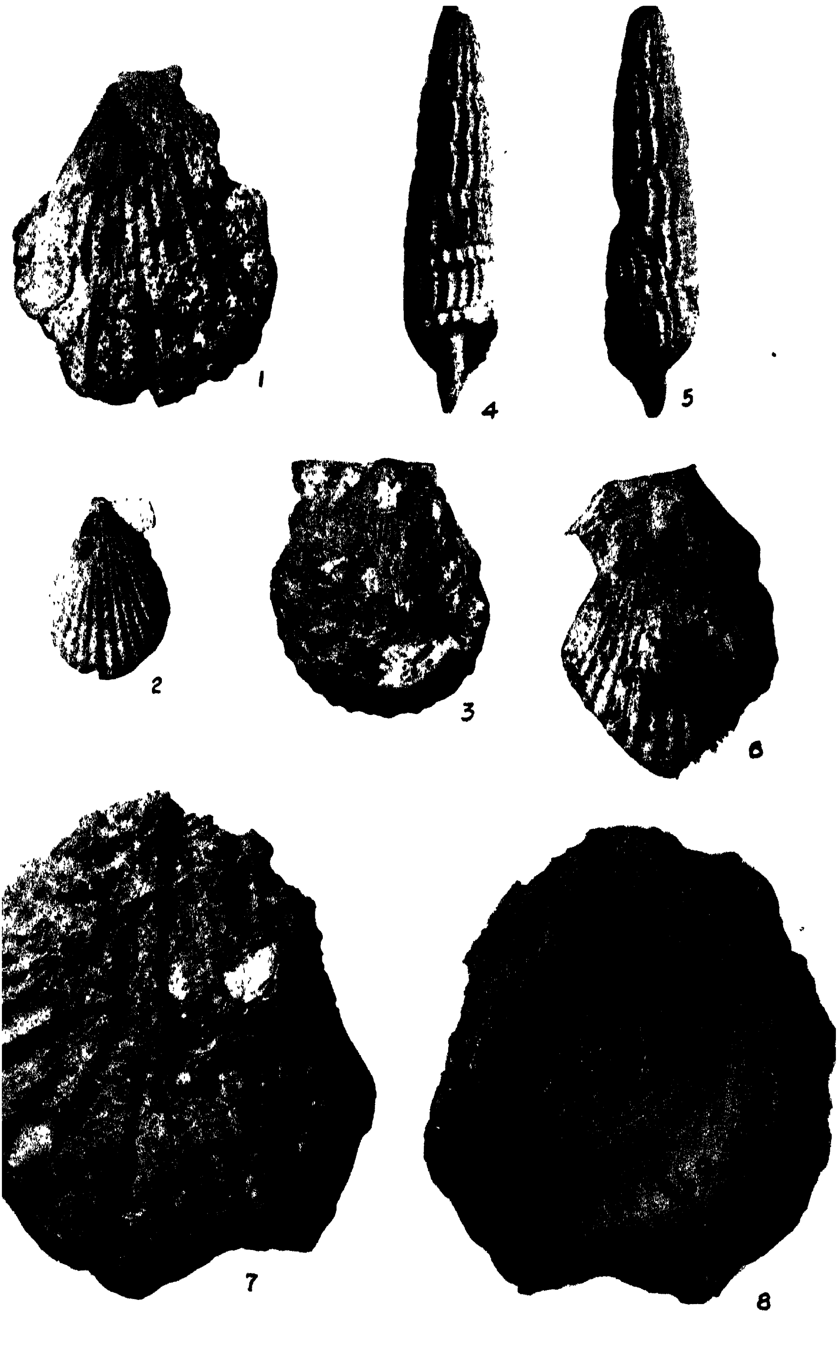
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Plate 23

Figs. 1, 2. *Ostrea heermanni* Conrad. Plesiotype, No. 1826 (C.A.S. Coll.), from Loc. 693.

Figs. 3, 4, 5. *Anomia subcostata* Conrad. Plesiotypes, Nos. 1813, 1814, 1815 (C.A.S. Coll.), from Loc. 684.

Fig. 6. *Metis excavata* Sowerby. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1841 (C.A.S. Coll.).

Fig. 7. *Carcharodon arnoldi* Jordan. Plesiotype, No. 324,542 (U.S.N.M. Coll.); cast of same, No. 1842 (C.A.S. Coll.).


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Plate 24

Fig. 1. *Metalia spatagus?* (Linnæus). Plesiotype, No. 324,541 (U.S.N.M. Coll.); cast of same, No. 1822 (C.A.S. Coll.).

Fig. 2. *Pecten mediacostatus* Hanna, n. sp. Type, No. 1830 (C.A.S. Coll.), from Loc. 681.

Figs. 3, 4. *Spondylus bostrychites* Guppy. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1840 (C.A.S. Coll.).

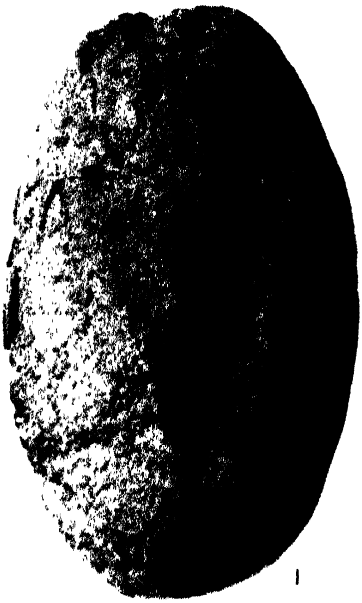

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Plate 25

Figs 1, 2, 3. *Pecten deserti* Conrad. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1844 (C.A.S. Coll.)

Figs 4, 5. *Pecten mendenhalli* Arnold. Plesiotype from Loc. 2064 (U.C. Coll.); cast of same, No 1833 (C.A.S. Coll.).

Fig. 6. *Pecten subnodosus* Sowerby. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1829 (C.A.S. Coll.).

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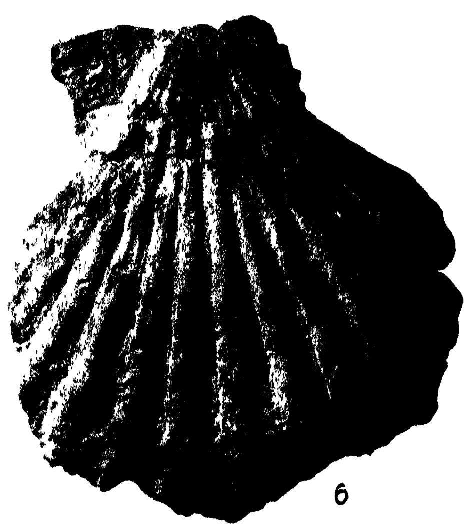

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Plate 26

Figs. 1, 2, 3. *Ostrea vespertina* Conrad. Plesiotype, from Loc. 738 (U.C. Coll.); cast of same, No. 1827 (C.A.S. Coll.).

Figs. 4, 5, 6, 7. *Ostrea iridescens* Gray. - Plesiotypes, Nos. 1823, 1824, from Loc. 692 (C.A.S. Coll.).

Figs. 8, 9. *Divaricella eburnea* (Reeve). Plesiotype, from Loc. 738 (U.C. Coll.); cast of same, No. 1820 (C.A.S. Coll.).

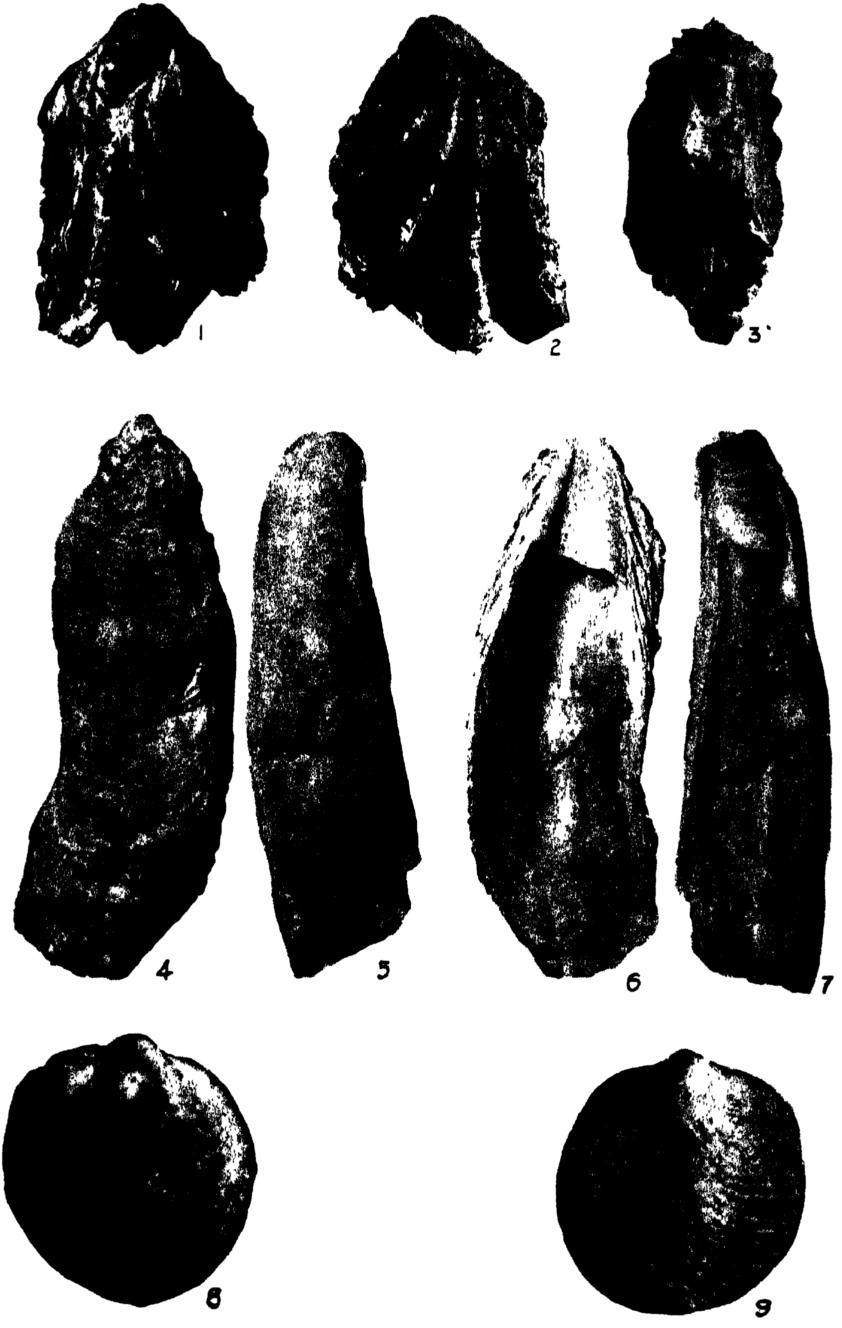
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Plate 27

Fig. 1. *Pinna latrania* Hanna, n. sp. Type, No. 324,593 (U. C. Nat. Mus. Coll.), from Loc. 3922 (U.S.G.S.); cast of same, No. 1827 (C.A.S. Coll.).

Fig. 2. *Pinna mendenhalli* Hanna, n. sp. Type, No. 324,593 (U. S. Nat. Mus. Coll.), from Loc. 3922 (U.S.G.S.); cast of same, No. 1839 (C.A.S. Coll.).

Figs. 3, 4. *Atrina stephensi* Hanna, n. sp. Type in San Diego Society of Natural History from Coyote Mountain, Imperial County, California; cast of same, No. 1816 (C.A.S. Coll.).


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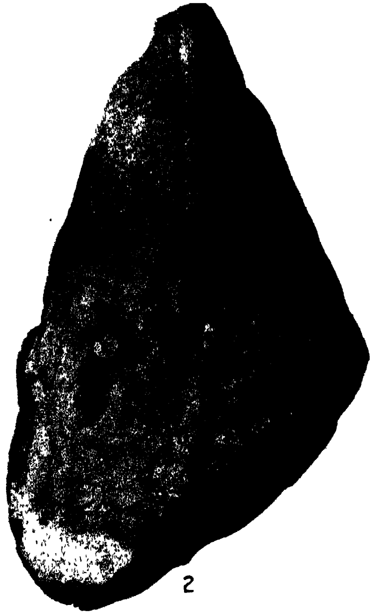
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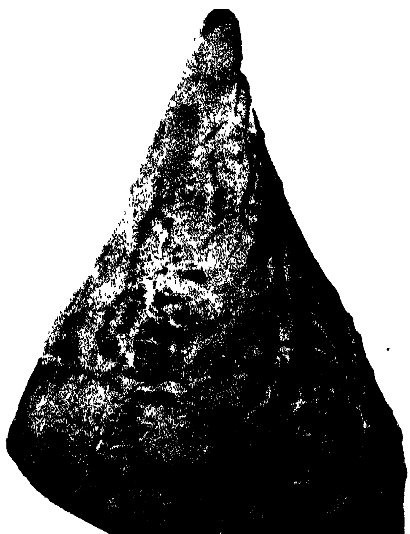
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Plate 28

Figs. 1, 2, 3, 4. *Crassatellites subgibbosus* Hanna, n. sp. Figs. 1, 2, from paratypes, from Loc. 738 (U.C. Coll.); casts of same, No. 1819 (C.A.S. Coll.); figs. 3, 4, from type, No. 1818 (C.A.S. Coll.), from Loc. 682.

Figs. 5, 6. *Barnea costata* (Linnæus). Plesiotype, No. 324,575 (U. S. Nat. Mus. Coll.), from Loc. 6847 (U.S.G.S.); cast of same, No. 1817 (C.A.S. Coll.).

Fig. 7. *Phacoides xantusi* Dall. Plesiotype, from Loc. 738 (U.C. Coll.); cast of same, No. 1836 (C.A.S. Coll.).


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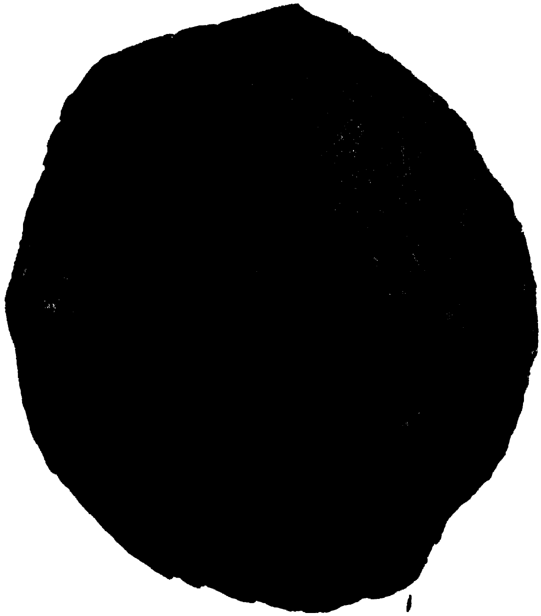
Plate 29

Fig. 1. *Phacoides xantusi* Dall. Plesiotype from Loc. 738 (U.C. Coll.); cast of same, No. 1836 (C.A.S. Coll.).

Figs. 1, 2. *Cassis subtuberosus* Hanna, n. sp. Type from Loc. 738 (U.C. Coll); cast of same, No. 1799 C.A.S. Coll.).



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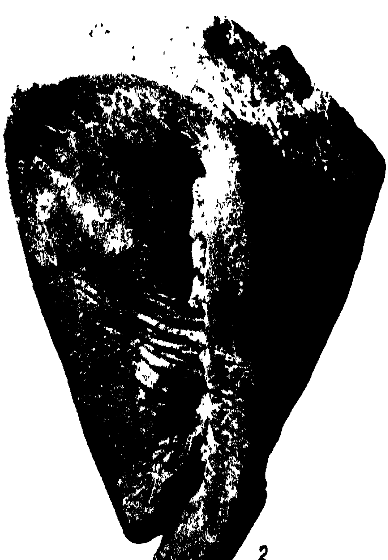

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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XIV, NOS. 19 AND 20, pp. 505-566 APRIL 28, 1926

XIX

REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1925

BY

C. E. GRUNSKY

President of the Academy

It is with pleasure and satisfaction that your President again calls attention in this Annual Report to progress made and to work done by the Academy, through its staff of scientists and their assistants, during the year 1925.

There has been but slight change in membership which now stands at 1099. The accession of new members and losses are shown in the following analysis:

Members on January 1, 1925		1107
New members, during 1925		77
Total		1184
Deceased in 1925	16	
Resigned	15	
Dropped for non-payment of dues	54	
Total		85
Members on January 1, 1925		1099

The membership consists of:

Patrons	16
Honorary members	23
Life members	87
Fellows	23
Members	950
Total	1099

The Academy carries on its list of patrons the following names:

Living

Mr. George C. Beckley
Dr. Frank E. Blaisdell, Sr.
Mr. William B. Bourn
Mr. William H. Crocker
Mr. Peter F. Dunne
Dr. Barton Warren Evermann
Mr. Herbert Fleishhacker
Mr. Joseph D. Grant
Mr. A. Kingsley Macomber
Mr. John W. Mailliard
Mr. Joseph Mailliard
Mr. M. Hall McAllister
Mr. Ogden Mills
Mr. William C. Van Antwerp
Mr. Edward P. Van Duzee
Dr. E. C. Van Dyke

Deceased

Mr. William Alvord
Mr. Charles Crocker
Mr. John W. Hendrie
Mr. Henry M. Holbrook
Mrs. Charlotte Hosmer
Mr. James Lick
Mr. Alexander F. Morrison
Mr. Amariah Pierce
Mr. Ignatz Steinhart
Dr. John Van Denburgh

The following list of members deceased during the year includes a number of those who have been active at one time or another in the Academy or who have in other ways than giving of their time aided the Academy in its scientific work. Mr. T. S. Brandegee and Miss Catherine Hittell are notable in this class and will be kept in grateful memory by all who knew them. And then there are many whose prominence among their fellow-men and whose friendly good will and active cooperation have been of material assistance to the Academy. I need mention only such names as Mr. John A. Hooper, Mr. M. H. de Young, Mr. I. H. Morse, and others. It was with particular regret that news of the passing of Prof. José M. Gallegos in September, 1925, was received so soon after his participa-

tion as a scientist delegated by Mexico in the Academy's Revillagigedo expedition.

Deceased

Mr. George H. Anderson	Member	September 12, 1925
Mr. T. S. Brandegee	Life	April 8, 1925
Mr. John I. Carlson	Member	January 10, 1925
Mr. Walter E. Dean	Life	July 13, 1925
Mr. M. H. de Young	Member	February 15, 1925
Mr. Kimball G. Easton	Member	March 22, 1925
Prof. José M. Gallegos	Member	September 24, 1925
Miss Catherine H. Hittell	Member	April 18, 1925
Mr. John A. Hooper	Member	1925
Mr. Ira Kahn	Member	September 11, 1925
Miss Gertrude Twyman	Member	1925
Sr. Don Manuel Villada	Honorary	1925

The following whose deaths occurred on the dates named are here recorded for the first time:

Dr. Gustav Hambach	Member	June 20, 1922
Mr. John L. Koster	Member	December 1, 1923

In the year 1925 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

JANUARY 7.....A Naturalist's Visit to northern British Columbia, illustrated, by Mr. H. S. Swarth, Curator of Birds, Museum of Vertebrate Zoology, University of California.

MARCH 4......Salt Water Barriers, illustrated, by Dr. C. E. Grunsky, President California Academy of Sciences.

APRIL 1........Symposium on the proposed Revillagigedos Expedition of the California Academy of Sciences, participated in by various members of the Museum staff.

MAY 6.........The Wild Flowers of Western Canada, illustrated with colored slides, by Mr. W. C. McCalla, Edmonton, Alberta, Canada.

JUNE 3........San Francisco during the Seventies, illustrated, by Mr. Charles B. Turrill, San Francisco, California.

JULY 1........An Account of the Recent Revillagigedo Islands Expedition, illustrated, by Dr. G. Dallas Hanna, Curator of the Department of Paleontology, California Academy of Sciences.

AUGUST 5......Flowers of the northern Sierra Nevada, illustrated, by Miss Alice Eastwood, Curator of Botany, California Academy of Sciences.

SEPTEMBER 2...Fish and Game Protection, illustrated, by Mr. E. R. Zion, San Francisco, California.

OCTOBER 7.....Ears, by Dr. J. Sterling Kingsley, Berkeley, California.
NOVEMBER 4....The Biology of Our Introduced Rats, illustrated, by Mr. Tracy I. Storer, Assistant Professor of Zoology, University of California.
DECEMBER 2....Number, by Dr. Rufus L. Green, Professor of Mathematics, Stanford University.

The Sunday afternoon lectures at the Museum building were continued throughout the year except during the vacation months of summer. Despite the inadequacy of the temporary lecture room, the attendance at these lectures has been satisfactory. These lectures have included the following:

JANUARY 4.....The California School System and Teacher Training, by Dr. Archibald B. Anderson, President, San Francisco State Teachers' College.
JANUARY 11....The Training of Teachers for the Public Schools, by Dr. W. W. Kemp, Dean of the School of Education, University of California.
JANUARY 18....Answering the Critics of the Public Schools, by Dr. Harry B. Wilson, Superintendent, Berkeley Public Schools.
JANUARY 25....The Aim of High School Education and how we are attaining it, by Mr. J. P. Nourse, Principal, Galileo High School, San Francisco.
FEBRUARY 1....Knowing How and Why, by Dr. Ray Lyman Wilbur, President of Stanford University.
FEBRUARY 8....California's Program of Education, by Hon. Will C. Wood, State Superintendent of Public Instruction.
FEBRUARY 15...Early Spring Flowers of the Bay region, illustrated, by Miss Alice Eastwood, Curator of Botany, California Academy of Sciences.
MARCH 1......Why Education in America is Difficult, by Dr. Ellwood P. Cubberley, Dean of the School of Education, Stanford University.
MARCH 8......The Financial Aspects of Education in California, by Mr. A. R. Heron, Assistant Superintendent Public Instruction, Sacramento.
MARCH 15.....Peoples of the Philippines, illustrated, by Prof. E. D. Merrill, Dean of the College of Agriculture, University of California.
MARCH 22.....Bird and Animal Friends, illustrated with motion pictures, by Mr. William L. Finley, expert photographer of wild animal life and noted naturalist and lecturer; and
Cruising the British Columbia Coast, illustrated with motion pictures, by Mr. Arthur Newton Pack, Secretary, American Nature Association and Associate Editor of Nature Magazine.

MARCH 29..... Corals: What they are, what they eat, and how they grow, illustrated, by Dr. T. Wayland Vaughan, Director, Scripps Institution for Biological Research, La Jolla, California.

APRIL 5........A Glimpse of the State University at work, by Dr. Monroe E. Deutsch, Dean of the College of Letters and Science, University of California.

APRIL 12.......The Lure of California's National Forests, illustrated, by Mr. Wallace Hutchinson, United States Forest Service, San Francisco.

APRIL 19.......The Life of the Forest, by Dr. E. P. Meinecke, Consulting Pathologist, United States Forest Service, San Francisco.

APRIL 26.......California's Forest Fire Problem, illustrated, by Mr. Paul G. Redington, District Forester, United States Forest Service, San Francisco.

MAY 3.........National Forest Highways and Byways, illustrated, by Mr. Frank Bonner, United States Forest Service, San Francisco.

MAY 10........Conceptions of the Earth as a Whole: Measuring the Earth and Mapping its Surface, illustrated, by Dr. George F. McEwen, Oceanographer and Curator of the Oceanographic Museum, Scripps Institution for Biological Research, La Jolla, California.

OCTOBER 4......Travel and Big Game Hunting in East Africa, illustrated, by Major Norman B. Livermore, San Francisco, Calif.

OCTOBER 11.... The Plants and Animals of Fanning and Washington Islands, Equatorial Coral Islands of the Pacific, illustrated, by Dr. W. B. Herms, Professor of Parasitology, University of California, Berkeley, California.

OCTOBER 18.... Among the Gilbertese Natives of Certain Equatorial Coral Islands of the Mid-Pacific Ocean, illustrated, by Dr. W. B. Herms, Professor of Parasitology, University of California, Berkeley, California.

OCTOBER 25.....The Alps of the King-Kern Divide, illustrated, by Mr. John J. Mazza, San Francisco, Calif.

NOVEMBER 1....Some Interesting Animals, a chalk talk for the children, illustrated, by Dr. J. Sterling Kingsley, Berkeley, California.

NOVEMBER 8....The Biology of Our Introduced Rats, illustrated, by Dr. Tracy I. Storer, Assistant Professor of Zoology, University of California.

NOVEMBER 15...The Maori, New Zealand Tourist Resorts and the Pacific Islands, illustrated, by Mr. F. E. Tomlinson, Official Publicity Photographer of New Zealand.

NOVEMBER 22...The High Sierra from Yosemite to Mount Whitney, illustrated, by Mr. Francis P. Farquhar, San Francisco.

November 29...Timbuctoo and the Land of the Blacks, illustrated, by Dr. David P. Barrows, Professor of Political Science, University of California.

December 6....The People of Santo Domingo, illustrated, by Mr. M. E. Beall, Berkeley, California.

December 13...The Largest and Oldest Living Things in the World, in the Sequoia and General Grant National Parks, illustrated with stereopticon slides, by Colonel John R. White, Superintendent Sequoia and General Grant National Parks.

December 20...The Apache Trail, illustrated with stereopticon slides and motion pictures, by Mr. Harry S. Swarth, Curator of Birds, Museum of Vertebrate Zoology, Berkeley, California.

The continued contribution of the Academy to the advancement of science is evidenced by the following list of publications issued by the Academy in 1925:

OCCASIONAL PAPERS No. XI—Fauna and Stratigraphic Relations of the Tejon Eocene at the Type Locality in Kern County, California, by Frank M. Anderson and G. Dallas Hanna.

Vol. XI, 1921—Index, Title Page and Contents of the Proceedings of the California Academy of Sciences for 1921.

Vol. XIII, No. 27, pp. 431-440—Report of the President of the Academy for the Year 1924, by C. E. Grunsky.

Vol. XIII, No. 28, pp. 441-494—Report of the Director of the Museum for the Year 1924, by Barton Warren Evermann.

Vol. XIII—Index, Title Page and Contents of the Proceedings of the California Academy of Sciences for 1923.

Vol. XIV, No. 1, pp. 1-35—Pectens from the Tertiary of Lower California, by Leo G. Hertlein.

Vol. XIV, No. 2, pp. 37-75—Contribution to the Tertiary Paleontology of Peru, by G. Dallas Hanna and Merle C. Israelsky.

Vol. XIV, No. 3, pp. 77-81—A Note on two of Hyatt's Liassic Ammonites, by C. H. Crickmay.

Vol. XIV, No. 4, pp. 83-87—A New Species of Mollusk *(Dentalium hannai)* from Lower California, with Notes on other Forms, by Fred Baker.

Vol. XIV, No. 5, pp. 89-100—Contributions to Oriental Herpetology II. Korea or Chosen, by Joseph R. Slevin.

Vol. XIV, No. 6, pp. 101-103—Contributions to Oriental Herpetology III. Russian Asia and Manchuria, by Joseph R. Slevin.

Vol. XIV, No. 7, pp. 105-142—New North American Spiders, by Ralph V. Chamberlin.

Vol. XIV, No. 8, pp. 143-169—Anatomy of Lanx, a Limpet-like Lymnæid Mollusk, by H. Burrington Baker.

Vol. XIV, No. 9, pp. 171-173—Expedition of the California Academy of Sciences to the Gulf of California in 1921, the Phalangida, by Ralph V. Chamberlin.

Vol. XIV, No. 10, pp. 175-183—Scellus virago Aldrich (A two-winged Fly) and two forms closely related to it, by M. C. Van Duzee.

Vol. XIV, No. 11, pp. 185-215—Bees in the Collection of California Academy of Sciences, by T. D. A. Cockerell.

Vol. XIV, No. 12, pp. 217-275—Expedition to Guadalupe Island, Mexico, in 1922, General Report, by G. Dallas Hanna.

Vol. XIV, No. 13, pp. 277-320—Expedition to Guadalupe Island, Mexico, in 1922, the Birds and Mammals, by A. W. Anthony.

Vol. XIV, No. 14, pp. 321-343—Expedition to Guadalupe Island, Mexico, in 1922, the Coleoptera, by Frank E. Blaisdell, Sr.

Vol. XIV, No. 15, pp. 345-367—Anthidiine Bees in the Collection of the California Academy of Sciences, by T. D. A. Cockerell.

Vol. XIV, No. 16, pp. 369-390—Studies in the Tenebrionidæ, No. 2, (Coleoptera), by Frank E. Blaisdell, Sr.

Vol. XIV, No. 17, pp. 391-425—New Hemiptera from Western North America, by Edward P. Van Duzee.

The present net income of the Academy, apart from funds received from San Francisco for the operation and maintenance of the Steinhart Aquarium, is about $80,000. Of this amount about $10,000 is annually applied to a reduction of indebtedness and the rest is expended on scientific research work and the upkeep of the Academy's exhibits. Both the Museum and the Aquarium are open to the public daily without charge.

The wisdom of the arrangement with the lessee of the Academy's Market Street property made in 1909, according to which the rent is readjusted frequently, based on reappraisals of the value of the real estate, is amply demonstrated by the actual result. There was, as the result of such reappraisal in 1924, an increase in income due to this cause alone of $8,712. The gross income from this property in the year 1926 is estimated at $92,097 from which, to determine net income (without allowance for depreciation), there should be deducted $12,925, the interest on the unpaid balance of the loan secured by this property which now stands at $235,000, it having been reduced $15,000 in the past year.

The Academy has received a number of valuable bequests and donations during the year which include the bequest of the late Henry M. Holbrook, preliminarily noted in last year's report of the President, of a notable collection of moths and

butterflies together with $2,000 for the installation of this collection. A very handsome and instructive exhibit has resulted.

Dr. Frank E. Blaisdell (under date of Aug. 22, 1925) presented to the Academy his collection of over 100,000 specimens of Coleoptera. This donation of great scientific value has followed closely that made by Dr. E. C. Van Dyke in December, 1924, which, as noted in last year's report, is also estimated at over 100,000 specimens.

Mr. Edward P. Van Duzee, Curator of Entomology, under date of August 4, 1925, presented to the Academy his collection of more than 30,000 specimens of Hemiptera. This collection probably excels any other collection of this order in this country.

In grateful recognition of these valuable donations Dr. Edward C. Van Dyke, Dr. Frank E. Blaisdell and Mr. Edward P. Van Duzee are now classed as Patrons of the Academy.

Another important contribution to the material in the Department of Entomology was made by John E. Carey in January, 1925. This consists of 500 specimens of Lepidoptera collected in Panama.

Mr. Ogden Mills has added $1000 to sums previously contributed in order that the setting of the Grizzly Bear habitat group might be improved. The rearrangement of this group is now in progress,—the work being done with funds contributed by Mr. Mills.

The most notable scientific activity of the Academy during the past year was an expedition to the Revillagigedo Islands, of which a detailed account is presented in the report of the Director of the Museum. Thanks to the interest of the Secretary of the Navy, Curtis D. Wilbur, the cooperation and assistance of the United States Navy Department was secured and the U. S. mine sweeper *Ortolan* was detailed to convey the scientists to and from the islands. Sailing on April 15, 1925, each of the islands in the group was visited and the expedition returned on June 12, bringing much new information and valuable collections which will be studied with publication of results in due course.

The Library continues to grow. Many new accessions of valuable publications and occasional rare editions of scientific

books have been made possible by a somewhat larger allotment of funds for the purpose than usually available.

The Steinhart Aquarium has been operated with scrupulous adherence to the requirement that expenditure be kept within the amounts of funds allotted by the City and County of San Francisco for its operation. The Academy has exercised great care in keeping its requests for funds as low as compatible with efficient management. Nevertheless, the allotted funds have been somewhat below the actual needs, with the result that there has had to be some curtailing of the program of collecting specimens. The continued popularity of the Aquarium evidenced by large attendance is gratifying proof of its value as an educational adjunct to the Academy and as a source of much pleasure and benefit to multitudes of people.

The Academy, through a Committee under the leadership of Mr. M. Hall McAllister, continues, among other activities, its cooperation with other organizations in the preservation of wild life. In this matter, as in any others related to the natural sciences, the Academy is at all times ready to act as trustee and would be only too glad to be placed in command of facilities that would permit large increase of its activities.

The need for more space for the research work of the curators and their assistants and for natural history exhibits, and the need of an adequate auditorium, grows more pressing from day to day. Year after year in our annual reports attention has been called to this pressing requirement to permit the Academy to function properly. Aside from a small annual sinking fund (about $10,000) which is being applied to a reduction of the indebtedness which was incurred when the Academy's Market Street property was improved by the erection of a modern 10-story office building, all of the Academy's income is expended in research work and in maintaining and adding to its research collections and exhibits. The public is, perhaps, not as fully advised of the contributions which the Academy has made to the advancement of science as it should be. The results of studies along lines of natural history do not as a rule lend themselves to spectacular display. The hardworking entomolgist, ornithologist, botanist, herpetologist, paleontologist, ichthyologist, as the case may be, is content to find the results of his studies made of record in printed

form for the use and benefit of mankind. His is the satisfaction in the doing and in the knowledge that in some measure he has broadened the foundation on which civilization rests. The great mass of the people, however, do not see what is being so laboriously and so well done on most slender means.

As this year marks the tenth anniversary of the completion and opening of the first unit of the Academy's museum building in Golden Gate Park, it will be fitting to review briefly the activities of the Academy during this decade with the hope that the further financial assistance for increased activity and usefulness may not be too long deferred.

Before presenting this condensed review, a word may not be out of place in appreciation of the generous endowments and bequests which have made the Academy's activities possible. These are small in the aggregate compared with some of the munificent endowments of similar institutions and colleges of learning on the Atlantic Coast and in the Middle West. There is to be noted, for example, the recent Munsey bequest of some $20,000,000 to the Metropolitan Museum of Art at New York; the $2,000,000 gift by Mr. J. G. Shedd of Chicago for an aquarium; $1,000,000 endowment by Henry T. Towne of New York for a Museum of Peaceful Arts; Julius Rosenwald's $1,000,000 toward the establishment of an Industrial Museum; and the Wilson Catherwood bequest of $250,000 to the Zoological Society of Philadelphia, besides more than $70,000,000 in recent years which have been placed at the disposal of universities or to be used in establishing new institutions of learning.

The endowments and bequests have, like all similar provisions for repositories of knowledge and for research, helped not alone to make for the progress of mankind, but, also, to establish that balance so essential from the economic standpoint between the producing class and the non-producers or consumers, which is every country's safeguard of continued and dependable prosperity. It is obvious that practically all outgo for scientific research gets into local circulation. It goes for the necessities of life, for food, shelter, clothing, education, recreation, transportation and what not. It goes from hand to hand at least 12 times in a year. Our little budget, for example, of $75,000 to $80,000 will probably account for

nearly $1,000,000 of business annually within California, to the advantage of both middleman and producer. From the economic standpoint, therefore, the liberal endowment of such institutions as this Academy is amply justified and no more appropriate outlet for large accumulations of wealth than in the making of such endowments and bequests to worthy institutions could possibly be found.

The first large scale aid came to the Academy from James Lick, to whom it is indebted for the Market Street lot between Fourth and Fifth Streets now worth over $800,000, the building on which produces a net annual return of about $75,000.

Next in the order of magnitude is the Ignatz Steinhart bequest of $250,000 for the Aquarium, to whose popularity a phenominally large list of visitors bears ample and gratifying testimony.

Then there is a fund of $20,000 contributed by Charles Crocker to aid in compensating those engaged in scientific studies; $5,000 contributed by Wm. Alvord for use by the Department of Botany and a $10.000 bequest by John W. Hendrie to assist in publishing papers on scientific subjects, besides a large number of donations for the installation of habitat groups and other exhibits ranging in amount from $50 to over $8,000, but which amount in the aggregate to more than $40,000.

Among the valuable collections which have enriched the Academy's stock of material in its various departments are the following:

Collections donated or bequeathed

Hemphill Collection (shells)
John W. and Joseph Mailliard Collection (ornithological and oological)
Kleeberger Collection (botanical)
E. C. Van Dyke Collection (entomological)
F. E. Blaisdell Collection (entomological)
E. P. Van Duzee Collection (entomological)
W. G. Wright Collection (entomological)
W. Otto Emerson Collection (ornithological)
John Van Denburgh Collection (ornithological and oological)
John Van Denburgh (library)
L. S. Smith (library)
Barton W. Evermann (library)

Collections purchased with contributed funds

Edward H. Taylor (herpetological)
Prager Collection (botanical)

And now as to a summary of what has been accomplished in these recent years:

1. The first unit of the museum building of the Academy in Golden Gate Park was completed and dedicated in 1916.
2. The Steinhart Aquarium as an adjunct of the Academy's buildings in Golden Gate Park was completed and opened to the public in 1923.
3. The available 18 large-size alcoves (17 in the museum building and one in the aquarium) have been filled with high class exhibits of birds and mammals in natural environment.
4. The research collections of material in the several departments have made steady and in some departments phenomenal growth, so that, despite the almost complete loss of material in the fire of 1906, these collections are now quite notable as will appear from the following brief summary.

The Botanical Department of the California Academy of Sciences was not reestablished until 1912. From the nucleus of types saved from the great fire, the collection has grown so as to fill 81 cases, 31 of which on account of restricted space have had to be placed in the hall of the research wing of the Museum Building adjoining the Botanical Department. There are now 138,432 specimens in the herbarium, mounted, numbered and stamped. It is the most cosmopolitan collection on the Pacific Coast and is unsurpassed in its collection of the exotics which are cultivated out of doors in California and which represent plants from all parts of the world. It is considered the Pacific Coast authority on these plants and is constantly consulted. The herbarium is also rich in Alaskan and Yukon plants and probably has the best collection on the Pacific Coast. Our Californian collection is fairly complete though still surpassed by collections in other herbariums of the Pacific Coast which have had much longer time in which to accumulate material and which have had many more collectors.

Valuable additions have been made by exchange with some of the large herbariums of the world. The Royal Herbarium

at Kew, England; the National Herbarium at Washington; the Gray Herbarium, Cambridge, Mass.; the Arnold Arboretum, Jamaica Plain, Mass.; and the New York Botanical Garden have all been most generous in making exchanges.

The greatest donation was that of the Prager Herbarium, which was purchased in 1921 through the generosity of Wm. H. Crocker, Wm. F. Herrin, A. F. Morrison, J. C. Augsbury, J. D. Grant, Wm. M. Fitzhugh and Wm. C. Van Antwerp. This was one of the largest private herbariums in Germany and added about 26,000 species and over 50,000 specimens to the Academy's herbarium. This collection is especially rich in Australian, South African, Asia Minor and Arctic and European species and contains many paratypes.

Doctors Fred and Charlotte Baker donated a valuable collection which they made in Japan and China. Professor R. Kleeberger donated his herbarium, which included his own collections made in Connecticut and also a set of the Kellogg and Harford collections made in California in the 1860's. Mrs. Abbott gave the Academy her deceased husband's collection known as the Dr. E. K. Abbott collection. It is rich in specimens from Monterey County, also in a collection from France made many years ago in the region memorable as the chief seat of the world war. Valuable collections from Chile and from China have been secured by purchase. The specimens collected on the various expeditions elsewhere noted have added many species to the collection besides furnishing valuable material for exchange.

The Academy's paleontological collection was entirely destroyed in 1906. It has since then been restored to greater size. The specimens run into millions. Invertebrate paleontology of western North America is better represented in the Academy's collection than anywhere else. Much comparative material is in the collection obtained from many typical localities elsewhere in the world. The collection of organic shales, which have a definite relation to the pretroleum industry, is by far the largest in existence. In the collection of type material the number of catalogued specimens of various kinds now exceeds 2000. The growth of the entire paleontological col-

lection is reported by the Curator to have made a phenomenal growth in the last ten years. Because of inadequate space in the main laboratory it has been necessary to store temporarily many hundreds of thousands of specimens in the almost inaccessible basement of the Museum building.

The Academy's ornithological collection is best developed in marine birds, shore birds and ducks and geese. The specimens of birds in the collection (skins, skeletons and alcoholics) now number 39,425. The sets of eggs number 8,991. The important accessions are as follow:

Birds

Galapagos Exhibition, 1905-6, 8688 skins.

Dr. Louis B. Bishop, April 6, 1907, 369 skins (gift).

California Fish and Game Commission, April 4, 1908, 102 skins (gift).

Mr. Theodore J. Hoover, August 13, 1909, 1121 specimens (gift).

Mrs. Alice Locke, Sept. 23, 1911, 263 specimens (purchase).

Emerson Collection (W. H. Crocker), September 16, 1920, 706 specimens (gift).

Emerson Collection (John W. Mailliard), September 16, 1920, 1110 specimens (gift).

Mailliard Collection (J. & J. W. Mailliard), 10,785 specimens, 1919 (gift).

Gulf of California Expedition, 1921, 25 specimens (exploration).

Lower California Expedition, 1922, 126 specimens (exploration).

Revillagigedos Expedition, 1925, 534 specimens (exploration).

Mr. J. August Kusche, June 21, 1921, 152 specimens from Australia and the Solomon Islands (purchase).

Mr. C. J. Wilson, December 15, 1922, 81 specimens from the Malay Peninsula (gift).

Eggs

Mailliard Collection (Gift of J. & J. W. Mailliard), 1919, 3,270 sets.

Galapagos Expedition, 1905-06, 818 sets (exploration).

Gulf of California Expedition, 1921, 511 set (exploration).

Revillagigedos Expedition, 1925, 59 sets (exploration).

Dr. John Van Denburgh (through Mr. Douglas Van Denburgh), November 6, 1924, 1311 sets and 16 nests (gift). Of particular value because of the 29 sets of Golden Eagle.

Dr. Harry R. Painton, December 8, 1924, 386 sets (gift).

The Academy possesses 1 egg of California Vulture (value $750); 1 egg of Black Swift (value $75); and a fine series of the eggs of the Elegant Tern and Aleutian Sandpiper. Of the last two the Academy probably possesses the finest series extant.

Dr. G. Dallas Hanna (Pribilof collections), 769 sets (exploration).

Of Mammals there are in the Academy 5250 specimens (skins and skulls). Among the principal accessions of these are to be noted:

W. W. Price Collection, 991 skins, small mammals from Eldorado and Mono counties; and Douglas County, Nevada.
H. O. Jenkins Collection, 506, chiefly Monterey and Santa Clara counties.
Mr. A. K. Macomber, Gorilla from Belgian Congo, July 25, 1924.
Lower California Expedition, 1921, 70 specimens.
Galapagos Expedition, 1905-06, 120 specimens.

During the past ten years the Academy's Department of Entomology has grown from a small unorganized collection until it now ranks among the large collections of the country, containing approximately 500,000 specimens, and, so far as west American material is concerned, probably takes first rank, with a very large proportion of its material carefully determined and well arranged in systematic order and therefore available for comparison and study. The following valuable collections, as already noted, have recently been added to the Academy's material:

The E. C. Van Dyke Collection of over 100,000 specimens. Coleoptera.
The F. E. Blaisdell Collection of over 100,000 specimens. Coleoptera.
The E. P. Van Duzee Collection of over 30,000 specimens. Hemiptera.
John E. Carey Collection of over 900 Lepidoptera.

The Academy's collection of reptiles and amphibians has been re-built since 1906. It now numbers over 59,000 specimens and is one of the largest in America. The collection of Galapagos tortoises is the largest and most complete in existence. The collection from the Pacific Coast is unsurpassed by any other museum. The oriental collections are large and valuable.

The Academy's library, too, is notable. This now consists of an extensive and valuable collection of books, periodicals and pamphlets on all branches of natural history and related subjects.

For a fuller understanding of the work which has been accomplished by the Academy, reference should be had to its

publications, of which the enumeration elsewhere in this report of the publications in 1925 gives a fair idea. This report would become too extended to attempt a review of the published material, even though restricted to the last ten years only.

It is a pleasure to be able thus to present in condensed form the results of the Academy's activities and it is only necessary to refer to this summary to show how enthusiastic and able has been the work of the Academy's curators and their assistants. For them and for the Academy itself let me hope for further continuous and generous encouragement and support by the public whom the Academy is endeavoring to serve. To all who have in any way contributed to the Academy's activities and successes, it makes grateful acknowledgment.

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REPORT OF THE DIRECTOR FOR THE YEAR 1925

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

The annual report of the Director for the year 1924 was presented to the Academy at the annual meeting, February 18, 1925.

The scientific and educational activities of the Museum were maintained during the year 1925 in a satisfactory manner. The members of the scientific staff have been active not only in adding to the collections in their respective departments but also in arranging and classifying the collections and in research work.

PERSONNEL

The personnel of the Museum staff has not greatly changed. Mr. Frank Yale, who had been in the service of the Academy many years, died March 12, 1925. Miss Margaret Dold, Library Assistant, resigned May 28 to accept a position in the Mechanics Institute Library; Frank Ashworth, assistant janitor, left January 8, 1925, and was succeeded by Ralph Borden January 12, who remained until February 22, when he was replaced by M. D. Phillips, who remained only a short time when William E. Nicherson served a few days, when he was followed by C. A. Bellas June 1 to August 31, Milward Lavin July 13 to September 4, and Hugh R. Jones September 12.

On July 1, the Department of Fishes was established with H. Walton Clark as Assistant Curator.

The employes of the Museum on January 1, 1926, were as follows: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum, Editor of the Academy publications and Director of the Steinhart Aquarium; W. W. Sargeant, Secretary to the Board of Trustees; Miss Susie M. Peers, Secretary to the Director; Joseph W. Hobson, Recording Secretary; Mrs. Constance W. Campbell, office assistant,

April 28, 1926

part time; Raymond L. Smith, office assistant; Miss Mabel E. Phillips, check-room attendant; Miss Alice Eastwood, Curator, and Mrs. Kate E. Phelps and Miss Clara Tose, assistants, Department of Botany; Edward P. Van Duzee, Curator; Dr. F. R. Cole, Curator in Dipterology; Hartford H. Keifer, Assistant Curator, and J. O. Martin, temporary assistant, Department of Entomology; H. Walton Clark, Assistant Curator, Department of Fishes; Joseph R. Slevin, Assistant Curator, Department of Herpetology; Dr. G. Dallas Hanna, Curator; Eric Knight Jordan, Assistant Curator, and Leo G. Hertlein, temporary assistant, Department of Paleontology; Joseph Mailliard, Curator, and Miss Mary E. McLellan, Assistant Curator, Department of Ornithology and Mammalogy; Dr. Walter K. Fisher, Curator, Department of Invertebrate Zoology; Frank Tose, Chief Taxidermist, and James F. Campbell, Russell Hendricks, Chandler Smith, Cecil Tose, Ralph Keating, Douglas Kelly, and Mrs. A. M. Hill, student assistants, Department of Exhibits; Edward P. Van Duzee, Assistant Librarian; C. A. Bellas, Library Assistant; William C. Lewis, janitor; Hugh Jones, assistant janitor; Mrs. Johanna E. Wilkens, charwoman; Patrick O'Brien, day watch; Archie McCarte, night watch.

Accessions to the Museum and Library

The accessions to the museum and library have been, as in former years, many and valuable. An itemized list is given in the appendix to this report (pp. 549-559). A few of the more notable are mentioned in the President's report (p. 516).

Cooperation with Public and Private Schools, with Other Institutions, and with Individuals

Cooperation of the Academy with the schools, other institutions, and individuals continues close and mutually helpful. An arrangement was made with Mrs. Anna V. Dorris, in charge of visual instruction in the public schools of Berkeley, whereby the following portable habitat groups were prepared for use in the Berkeley public schools: Western Robin, Western Meadowlark, San Francisco Towhee, California Shrike, California Woodpecker, Gila Woodpecker, Barn Owl,

Marsh Birds, Spring Pocket Mouse, Chickaree, Golden-mantled Ground Squirrel, California Ground Squirrel, and Weasel. These have been in constant use during the year. It is hoped that other groups may be prepared this year.

VISITORS TO THE MUSEUM IN 1925

The total number of visitors to the Museum in the calendar year 1925 was 553,423, the greatest in the history of the Museum with the exception of 1924, when it was 646,033.

The number of visitors by months and years since the opening, September 22, 1916, is shown in the following table:

Month	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
January ..	.....	23170	25260	17241	27013	25755	19038	15270	32364	34989
February .	.....	22058	23698	17586	23450	25679	18534	20529	44439	29295
March	.....	31606	26810	27397	25419	28279	27922	26341	39935	39168
April	.....	32175	23274	25994	32208	24939	36057	21911	41332	40257
May	.....	26154	26391	28369	37107	25517	27237	37597	48152	38137
June	.....	32123	29843	32248	36207	29406	27131	39511	58281	51775
July	.....	37193	31420	48028	52492	43186	36263	64530	91329	69921
August ...	.....	24619	31137	43730	53470	39422	34787	50849	105130	77847
September .	16448	27866	29847	34007	42013	31458	28408	69870	82814	63737
October ..	36933	20629	14743	30463	33500	24861	19459	66894	43074	40418
November .	27718	21810	8531	25246	19347	18593	19080	48766	37611	35634
December .	15002	21693	19588	21188	21340	15062	13339	36707	21572	32245
Total...	96101	321096	290542	351497	403566	332157	307255	498775	646033	553423

Total number of visitors since opening, September 16, 1916, has been 3,800,445.

The public and private schools of the state continue to avail themselves of the educational uses of the Museum and the research collections.

The number of schools visiting the museum is so great that we cannot print the list, much to our regret. The following summary must suffice:

Schools of San Francisco:		
Total Number Visiting Pupils	5643	5643
Total Number Visiting Teachers	169	
Total Number Visiting Classes	184	
Schools Outside of San Francisco:		
Total Number of Pupils	1373	1373
Total Number of Teachers	48	
Total Number of Classes	55	
		7016

MUSEUM ACTIVITIES AND GROWTH

The past year has witnessed commendable activity in each of the several departments of the Museum. The various curators and their assistants have shown great zeal and industry and have made excellent progress in the orderly arrangement and care of the collections in their charge. The field work was unusually extensive and productive, as set forth in detail in the respective departmental reports; mention need be made here of only a few of the more notable activities.

The U. S. S. *Ortolan* Expedition of the California Academy of Sciences to the Revillagigedo Islands was one of the most important ever sent out by the Academy. Our scientific staff for several years had been casting longing eyes toward that interesting group lying 300 to 600 miles off the Pacific coast of Mexico. As no very careful study had ever been made of the fauna and flora of those islands, it was believed that an expedition to them would yield results of considerable scientific importance and interest and add greatly to the natural history collections of the Museum.

Upon making our wishes known to the U. S. Navy Department, Secretary Curtis D. Wilbur very generously detailed the U. S. S. minesweeper *Ortolan* for the use of the Academy in making the survey.

The *Ortolan* outfitted at Mare Island Navy Yard, from which place she sailed on April 15, with M. M. Nelson, Lieutenant, U. S. Navy, in command.

The Academy was represented by the following: Dr. G. Dallas Hanna, curator of paleontology, in charge; Mr. Joseph R. Slevin, assistant curator of herpetology, assistant chief; Frank Tose, chief taxidermist; Hartford H. Keifer, assistant curator of entomology; Eric Knight Jordan, assistant curator of paleontology; H. L. Mason, botanist; John T. Wright, collector in ornithology and mammalogy; Raymond Duhem, official photographer.

Upon arriving at San Diego, where the *Ortolan* stopped to take on certain supplies, the scientific staff was joined by Professor Francisco Contreras, Director Museo Nacional de Mexico; Dr. Octavio Solis, Director of the Botanical Garden

of Chapultepec, Mexico, and Professor José Maria Gallegos, who accompanied the expedition as representatives of the Mexican government and as guests of the California Academy of Sciences.

Mention should be made of cooperation with the Scripps Institution for Biological Research whereby the Academy undertook to secure for the Institution samples of water and plankton at intervals along the route of travel.

A detailed general report of the expedition will be published soon.[1] The extensive collections obtained have been assigned for study and report to specialists in the various groups; their reports will be published in the Academy's Proceedings. Let it suffice to say at this time that the Expedition visited each of the islands of the Revillagigedo group (Clarion, Socorro, Roca Partida and San Benedicto), also Guadalupe Island to inspect the elephant seal rookery there, several islands of the Tres Marias archipelago, and a number of islands and stations in Lower California were visited en route northward and valuable collections made at each. This expedition, which returned to San Francisco June 10, is regarded as the most important and most successful the Academy has ever sent out.

Curator Mailliard of the Department of Ornithology and Mammalogy carried on field investigations in Siskiyou County, northern California, in May and June, in Placer County in June, July and December, and in Modoc County in September and October which resulted in important additions to our knowledge of the birds and mammals of those regions.

In September and October Assistant Curator Miss McLellan carried on investigations in the states of Sinaloa and Mayarit, Mexico, during which she obtained an excellent series of the birds of that region which will prove of much value in the study of the collections obtained at the Tres Marias Islands by the *Ortolan* expedition.

The growth of the Department of Entomology has been unprecedented. The additions to the Department's collections total more than 182,000 specimens. These include the Blaisdell collection of 100,000 Coleoptera and the Van Duzee collection of 30,000 Hemiptera.

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[1] This report has now been published. See Vol. XV, No. 1, pp. 1-113, of these Proceedings.

The additions to the collections in the Department of Herpetology numbers 3,253 specimens of reptiles and amphibians.

The Herbarium under Miss Eastwood's able and energetic management has grown by leaps and bounds and now numbers more than 138,000 sheets of mounted specimens.

The growth of the Department of Paleontology has been no less notable. The additions to the collections have been many and important, perhaps the largest being a very large and valuable series of minerals, fossils, and shells from the Philippines, Java, and Sumatra donated by Dr. Roy E. Dickerson, for several years the efficient and energetic curator of the Department.

The Department of Exhibits has been active in the preparation and installation of new habitat groups, chiefly of the small panel type, of which the following were completed within the year: California Woodpecker, Lazuli Bunting, Point Reyes Mountain Beaver, and Warner Mountain Cony. These are all excellently done and are very attractive exhibits.

The Library has received a good number of accessions by gift, exchange and purchase, the total being about 967 volumes and about 100 pamphlets.

For a number of years no binding was done, but this year 1163 volumes were bound at a cost of $1,614.75.

Use of the Academy Library and Collections by Investigators and Students

Use of the Academy library and the educational and research collections in the respective departments increases each year. While many of our members make use of the library, it is believed that many others would do so if they realized how well the library is now supplied with current scientific periodicals, outing magazines, standard works of reference, and recent authoritative publications in the various departments of physical and biological science. It is hoped that our members may get in the habit of visiting the library when they desire information in any department of science which can be found in our publications. Members and their friends are cordially invited to visit the various department laboratories and collections when they wish to see any species of animal or plant of

which we have specimens. In some of our departments the collections are quite extensive and the visitor will probably find specimens of the particular species he wishes to see.

Troop 20 of the Boy Scouts under Scout Master Harold E. Hanson, continues to meet weekly in the Academy's Auditorium. The Academy is glad to be able to extend this courtesy to the Boy Scouts. Various other organizations have from time to time held special meetings in our Auditorium.

CONSERVATION OF WILD LIFE

The Committee on the conservation of wild life has been active during the year. The annual meeting of the Committee was held February 10, 1926, at which reports of the various volunteer observers were read. The census of big game animals in each region where the Academy has an observer, is as follows:

Mountain Sheep

Inyo Mountains east of Big Pine, Edwin H. Ober, observer...	42
Riverside and San Bernardino counties, E. L. Hedderly, observer.	72
Mt. San Antonio, Los Angeles County, A. T. Shay, observer...	18
	132

Antelope

Mt. Dome, Siskiyou County and adjacent territory, John O. Miller, observer	175
Lassen County, W. G. Durbin, observer........	26
Fresno County; no report	
Kern County, Los Angeles Refuge, E. L. Hedderly, observer...	11
	212

Valley Elk

Kern County, Miller and Lux herd, L. E. Nance, observer.....	800
Yosemite Paddock, W. B. Lewis, observer........	13
Colusa and Yolo counties, C. Swanson, observer........	15
San Luis Obispo County, C. C. Rossi, observer........	11
Monterey County, C. S. Olmsted, observer........	30
Laguna Mountains, San Diego County, Dr. Harry M. Wegeforth, observer	35
	904

NATIONAL PARK REPORTS

Yellowstone National Park, Horace M. Albright, Supt.

Elk: Park, North herd	17,242	
Jackson Hole	19,442	
		36,685
Buffalo: Lamar River	753	
Cold Creek	125	
		878
Antelope		417
Mountain Sheep:		
Actual count	195	
Estimated	600	
		795
Moose:		
Actual count	170	
Estimated	525	
		695
Mule Deer		1,800
Whitetail Deer		12
Black Bear		200
Grizzly Bear		75

Grand Canyon National Park, J. Ross Eakin, Supt.

Mountain Sheep, estimated	500
Antelope, actual count	9
Deer, estimated	2,720
This does not include the Kaibab herd of deer which contains about	5,000

Zion National Park, Richard T. Evans, Supt.

Mountain Sheep, estimated	100
Mule Deer	500

McKinley National Park, Henry P. Karstens, Supt.

Caribou, estimated	30,000
Mountain Sheep	10,000

Grizzly Bear, quite plentiful.
Moose, not common in Park.

Glacier National Park, Charles J. Kraebel, Supt.

Moose, count	69
Elk, count	567
Deer, Blacktail, count	764
Deer, Whitetail, count	1,311
Mountain Sheep, count	724
Mountain Goat, count	943
Bear, Grizzly, count	51
Bear, Black and Brown, count	76

Crater Lake National Park, Charles Goff Thomson, Supt.

Bear	9
Deer, Blacktail	60

Rocky Mountain National Park, Colorado, Roger W. Toll, Supt.

Deer, Blacktail, estimated	3,000
Mountain Sheep, estimated	400
Elk, estimated	200
Bear, Black and Brown	35

Rainier National Park, Owen A. Tomlinson, Supt.

Deer, Blacktail, count	350
Mountain Goat, count	250
Bear, Black, count	200
Elk, count	15

M. HALL MCALLISTER, *Chairman.*

STEINHART AQUARIUM

The activities of the Aquarium for 1925 are fully covered in the report of the Superintendent. Let it suffice to say here that the Aquarium continues to grow in attractiveness and popular interest. The number of visitors for the year exceeded one million, including 382 school classes in charge of 350 teachers and containing 9,866 pupils.

The interest which the public takes in the Aquarium is shown not only by the large number of visitors but in many other ways; for example, various persons have given to the Aquarium within the year a total of 728 fishes, turtles, snakes and other live animals. On the other hand the Aquarium has given to schools and individuals during the year a total of 1,858 small aquarium fishes and other objects.

The Academy in this way encourages the use of small balanced aquariums in homes and schools.

Aquarium Personnel

A number of changes in the personnel of the Aquarium have taken place within the year, due chiefly to resignations on account of the inadequate salaries paid. The employes with scarcely an exception have been and are efficient and industrious, performing their respective duties with enthusiasm and pride, but better salaries must be paid if we are to retain the most efficient.

The present personnel is as follows:

Dr. Barton Warren Evermann, Director, part time; W. W. Sargeant, Secretary, part time; Susie M. Peers, Secretary to the Director, part time; Mrs. Constance W. Campbell, office assistant, part time; Alvin Seale, Superintendent; Wallace Adams, Assistant Superintendent; Herbert Brandt, collector; Clynt S. Martin, chief engineer; Warren R. Hayes, assistant engineer; P. E. Shepherd, assistant engineer; S. J. Shenefield, carpenter and general utility man; Charles Brandt, chief attendant; C. E. Guidry, assistant attendant; Robert J. Lanier, electrician and assistant attendant; Patrick O'Neill, janitor; Frank J. Maxwell, assistant janitor; Dora Arnold, doorkeeper; James Kavanaugh, police officer.

Acknowledgments

As in the past, many courtesies and favors of one kind or another have been shown the Academy by various organizations and individuals. Space does not permit individual acknowledgments of all, but the Academy is grateful to all who have helped it in any way and who have shown interest in its work. First, to those who have contributed to the educational program of the Academy by giving one or more lectures in our Sunday afternoon and Wednesday evening lecture courses, the grateful thanks of the Academy are due; also to those who have donated specimens to the departments or books to the library. Special mention should be made of the deep interest which the Southern Pacific Company, the Atchison, Topeka and Santa Fe Railway System, and the Los Angeles Steamship Company have shown in the scientific and educational work of the Academy. Each of these companies has

rendered material assistance to members of the staff in connection with their field studies of the fauna, flora, paleontology and geology of the state, and in making collections of live fishes for the Steinhart Aquarium. With their generous co-operation the Academy is able to carry on its research and educational work much more comprehensively and thoroughly than would otherwise be possible.

PUBLICATIONS BY THE MUSEUM STAFF

The following bibliography lists the papers published by the Museum and Aquarium staffs in the year 1925. In the case of Dr. Hanna it includes his 1924 titles inadvertently omitted from the annual report for that year.

Clark, H. Walton.

1. *Lymnæa auriculata* (Linn.) in California. <Nautilus, Vol. XXXVIII, No. 4, pp. 125-126, April, 1925 (With G. Dallas Hanna).

Eastwood, Alice

1. The Madroño. <California Out of Doors (Tamalpais Conservation Club organ), January, 1925.
2. Sequoia versus Eucalyptus. <California Out of Doors, April, 1925.
3. The Rose Family on Mount Tamalpais. <California Out of Doors, July, 1925.
4. The Aftergrowth of a Mountain Fire. <California Out of Doors, January, 1926.
5. Review of R. S. Ellsworth's The Giant Sequoia. <Bull. Sierra Club, Vol. XII, No. 2, pp. 204-205, 1925.
6. Annual Report, Department of Botany for 1924. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 28, pp. 467-468, May 29, 1925.

Evermann, Barton Warren

1. Save the Elephant Seals. <Catalina Islander, January 21, 1925.
2. Pollution of the Sea. <Mid-Pacific Magazine, Vol. XXIX, No. 3, March, 1925, pp. 563-565.
3. Report of the Director of the Museum (of the California Academy of Sciences) for the year 1924. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 28, pp. 411-487, May 29, 1925.
4. Are Elephant Seals destructive to the fisheries? <California Fish and Game, Vol. XI, No. 2, April, 1925, pp. 78-79.

5. The Steller Sea Lion Rookery on Año Nuevo Island, California, in 1924. (Joint author with G. Dallas Hanna). <Journal of Mammalogy, Vol. VI, No. 2, May, 1925, pp. 96-99, pls. 8-10.
6. John Van Denburgh, 1872-1924. <Science, N. S., Vol. LXI, No. 1585, May 15, 1925, pp. 508-510.
7. Museum of the California Academy of Sciences. <Municipal Record, San Francisco, Vol. XVIII, No. 33, p. 268, August 13, 1925.
8. Steinhart Aquarium (of the California Academy of Sciences). <Municipal Record, San Francisco, Vol. XVIII, No. 33, p. 276, 1 plate, August 13, 1925.
9. Earthquake Studies. <The Commonwealth, Vol. I, No. 17, pp. 205-206, September 1, 1925.
10. Natural Fisheries Resources of the Sea (chiefly of the Pacific) whose Conservation will require International Cooperation. <Fur Industry Year Book 1925, pp. 62-66.
11. The Marine Mammals of the Pacific. <The Columbia Port Digest, November, 1925, pp. 5-6.
12. A Check List of the Fishes of Hawaii (Junior author with David Starr Jordan). <Journal of the Pacific Research Institution, Vol. I, No. 1, January (December 31, 1925), 1926, pp. 2-15.
13. The Steinhart Aquarium. <The Amateur Aquarist, Vol. I, No. 10, winter 1925-26, pp. 113, 120 and 121.

Hanna, G. Dallas

1. *Succinea avara* Say, from the Pleistocene Tar Pits of California. <Nautilus, Vol. XXXVII, No. 3, p. 106, January, 1924.
2. Review of, "The Mollusca of the Southwestern States, XI." By Henry A. Pilsbry & James H. Ferriss. <Proc. Acad. Nat. Sci. Phila., Vol. LXXV, pp. 47-103, 1923. <Nautilus, Vol. XXXVII, No. 3, p. 107, January, 1924.
3. Sperm Whales at St. George Island, Bering Sea. <Journal of Mammalogy, Vol. V, No. 1, p. 64, February 9, 1924.
4. Temperature Records of Alaska Fur Seals. <Journal of Physiology, Vol. LXVIII, No. 1, pp. 52-53, March, 1924.
5. Rectifications of Nomenclature. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 10, pp. 151-186, March 18, 1924.
6. Freshwater Mollusks of Eagle Lake, California. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 7, pp. 131-136, 1 pl., March 18, 1924.
7. Description of a New Genus and Species of Freshwater Gastropod Mollusk *(Scalez petrolia)* from the Etchegoin Pliocene of California. By G. D. Hanna & E. G. Gaylord. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 9, pp. 147-149, 1 fig., March 18, 1924.
8. Smaller Foraminifera for Stratigraphy. <Bull. Am. Assn. Petrol. Geologists, Vol. VIII, No. 2, pp. 246-250, March-April, 1924.

9. A New Species of Whale from the Type Locality of the Monterey Group. By G. Dallas Hanna & Mary E. McLellan. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, No. 14, pp. 237-241, pls. 5-9, June 14, 1924.

10. Insects in the California Tar Traps. <Science (n.s.), Vol. LIX, No. 1538, p. 553, June 20, 1924.

11. Resignation of A. H. Proctor. (Unsigned.) <U. S. Dept. Commerce, Fisheries Service Bulletin, No. 111, August 1, 1924.

11a. Annual Report, Department of Invertebrate Paleontology for 1923. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XII, No. 33, pp. 1264-1265, October 10, 1924.

12. Review of "Indications of a Gigantic Amphibian in the Coal Measures of Kansas." By H. T. Martin. <Univ. Kans. Sci. Bull., Vol. XIII, No. 12, pp. 103-114, 3 pls., July, 1922. <Pan-American Geologist, Vol. XLII, No. 5, p. 235, October, 1924.

13. Foraminifera from the Eocene of Cowlitz River, Western Washington. By G. Dallas Hanna & Marcus A. Hanna. <Univ. Wash. Publ. Geol., Vol. I, No. 4, pp. 57-64, pl. XIII, October, 1924.

14. A Little about Diatoms. By G. Dallas Hanna with photographs, by W. M. Grant. <The Record (Associated Oil Company Publication), San Francisco, Vol. V, No. 9, pp. 6-8, 10 photographs, September, 1924.

15. The same, reprinted. <California Engineer (University of California), Vol. III, No. 4, pp. 107-108, 8 photographs, December, 1924.

16. Miocene Marine Vertebrates in Kern County, California. <Science (n.s.), Vol. LXI, No. 1568, pp. 71-72, January 16, 1925.

17. The Study of Subsurface Formations in California Oilfield Development. By G. Dallas Hanna & H. L. Driver. <10th Ann. Rept. Calif. St. Min. Bur., Oil & Gas Supervisor, Vol. X, No. 3 (Monthly Chapt. Sept. 1924), pp. 5-26, 10 figs. in text (Issued March 10, 1925).

18. Fauna and Stratigraphic Relations of the Tejon Eocene at the Type Locality in Kern County, California. By Frank M. Anderson & G. Dallas Hanna. <Occ. Pprs. Calif. Acad. Sci., Vol. XI, pp. 1-249, 16 pls., March 18, 1925.

19. Discussion of "Diatom Theory of Origin of Petroleum in California." By Jun-ichi Takahashi, Sendai, Japan. Read May 3, 1924, at Stanford Univ. Calif. before meeting of Cordilleran Section of Geological Society of America. <Bull. Geol. Soc. Am., Vol. XXXVI, No. 1, p. 207, March, 1925.

20. The Academy of Sciences expedition to the Revillagigedo Islands. <Science (n.s.), Vol. LXI, No. 1579, pp. 359-360, April 3, 1925. Published in Oakland Tribune, S. F. Examiner, Chronicle, Bulletin and Call.

21. Naturalists to Explore Strange Islands off Mexico. <San Francisco Examiner, Sunday, April 12, 1925, p. K 7, four photographs.
22. *Lymnæa auricularia* (Linn.) in California. By G. Dallas Hanna & H. Walton Clark. <Nautilus Vol. XXXVIII, No. 4, pp. 125-126, April, 1925.
23. Some Land Shells from the Aleutian Islands, Alaska. <Nautilus Vol. XXXVIII, No. 4, pp. 122-125, April, 1925.
24. Correlation of the Organic Shales of the San Joaquin Valley, California. By E. G. Gaylord & G. D. Hanna. <Bull. Am. Assn. Petrol. Geol., Vol. IX, No. 2, pp. 228-234, pls. 4-5, March-April, 1925.
25. (Annual Report, Department of Paleontology for 1924.) <Proc. Calif. Acad. Sci., Vol. XIII, No. 28, pp. 476-478, May 29, 1925.
26. The Steller Sea Lion Rookery on Año Nuevo Island, California, in 1924. By Barton Warren Evermann & G. Dallas Hanna. <Journ. Mammalogy, Vol. VI, No. 2, pp. 96-99, pls. 8-10, May, 1925.
27. Scientists return with Rarities from Islands off Mexico. <The San Francisco Examiner, Sunday, June 28, 1925.
28. Contribution to the Paleontology of Peru. By G. Dallas Hanna & Merle C. Israelsky. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIV, No. 2, pp. 37-75, pls. 7, 8, July 21, 1925.
29. Zalophancylus, a Fish Vertebra, not a Mollusk. <Nautilus, Vol. XXXIX, No. 1, p. 18, July, 1925.
30. Photograph of Fur Seal Census Taker on Pribilof Islands. <Popular Mechanics Magazine, Vol. XLIV, No. 1, p. 87, July, 1925.
31. The Extraction of Fossils from Refractory Rocks. <Journal of Geol., Vol. XXXIII, No. 5, pp. 555-557, July-August, 1925.
32. The Age and Correlation of the Kreyenhagen Shale in California. <Bull. Amer. Assn. Petrol Geolog., Vol. IX, No. 6, pp. 990-999, September, 1925. Read before September, 1924, Meeting of Pacific Section of Amer. Assn. Pet. Geol. at Los Angeles.
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34. Was there a Pacific Continent? <Science (n.s.), Vol. LXII, No. 1613, pp. 491-492, November 27, 1925.

Hertlein, Leo G.

1. Pectens from the Tertiary of Lower California. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIV, No. 1, pp. 1-35, July 21, 1925.
2. New Species of Marine Fossil Mollusca from Western North America. <Bulletin Southern Calif. Acad. Sci., Vol. 24, Pt. 2, pp. 39-46, 1925.

3. A Summary of the Nomenclature and Stratigraphy of the Marine Tertiary of Oregon and Washington (with Colin H. Crickmay). <Proc. Amer. Phil. Soc., Vol. LXIV, No. 2, pp. 224-282, 1925.

Jordan, Eric Knight

1. Notes on the Fishes of Hawaii with descriptions of six new species. <Proc. U. S. Nat. Mus., Vol. LXVI, 1925, Art. 33, pp. 1-43, pls. 1-2.

Mailliard, Joseph

1. Census of Birds' Nests in the Music Concourse, Golden Gate Park, San Francisco, California, for 1924. <The Gull, Vol. VII, No. 2, February, 1925.
2. Some New Rodent Records for Northeastern California. <Journal of Mammalogy, Vol. VI, No. 1, pp. 57-58, February 9, 1925.
3. Notes upon the Numerical Status of Rodent Populations in Parts of California. <Journal of Mammalogy, Vol. VI, No. 2, pp. 102-105, May 12, 1925.
4. Annual Report of the Department of Exhibits for 1924. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, Nos. 27-28, pp. 472-473, May 29, 1925.
5. Annual Report, Department of Mammalogy for 1924. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, Nos. 27-28, p. 475, May 29, 1925.
6. Annual Report, Department of Ornithology for 1924. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIII, Nos. 27-28, pp. 475-476, May 29, 1925.

Slevin, Joseph R.

1. Contributions to Oriental Herpetology, II. Korea or Chosen. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIV, No. 5, pp. 89-100, July 23, 1925.
2. Contributions to Oriental Herpetology, III. Russian Asia and Manchuria. <Proc. Calif. Acad. Sci., 4th Ser., Vol. XIV, No. 6, pp. 101-103, July 23, 1925.
3. Annual Report, Department of Herpetology for the year 1924. <Proc. Calif. Acad. Sci., Vol. XIII, No. 28, p. 473, May 29, 1925.

Van Duzee, Edward P.

1. Notes on a Few Hemiptera from the San Bernardino Mountains, California. <Bulletin Brooklyn Entomological Society, Vol. XX, pp. 89-90, April, 1925.
2. A Third Record for Emphoropsis depressa Fowler [Note]. <Pan-Pacific Entomologist, Vol. I, p. 155, May, 1925.
3. Annual Report, Department of Entomology for 1924. <Proc. Calif. Acad. Sci., Ser. 4, Vol. XIII, pp. 469-472, May, 1925.

4. Report on the Library for 1924. <Proc. Calif. Acad. Sci., Vol. XIII, p. 474, May, 1925.
5. [Note on] Luceria tranquilla Grote. <Pan-Pacific Entomologist, Vol. I, p. 185, May, 1925.
6. A new Mirid from Arizona. <Pan-Pacific Entomologist, Vol. II, p. 35, August, 1925.
7. [Note on] The Van Duzee Collection of Hemiptera. <Pan-Pacific Entomologist, Vol. II, p. 15, August, 1925.
8. New Hemiptera from Western North America. <Proc. Calif. Acad. Sci., Ser. 4, Vol. XIV, pp. 391-425, September, 1925.

Department Reports

Department of Botany

A total of 138,432 sheets of mounted herbarium specimens are now numbered and stamped. Of the 299 families of plants, according to the latest system of classification, all but 15 are represented in the herbarium. Ten of these consist of a single genus and have been removed from larger and well known families; the remaining five belong in the tropics and have few genera.

Several important collections by exchange and purchase which have added many rare species and genera to the herbarium have been acquired; 428 in exchange, chiefly North American from the National Herbarium, Washington, D. C.; 622 of the J. F. Duthie collection from the Himalaya Mountains, and 285 of the A. Stolz collection from Lake Nyassa, Africa, by exchange from the Royal Herbarium, Kew, England; 375 Chilian plants purchased from the collector, Dr. E. Werderman, an authority on Chilian plants; 185 Chinese plants, a continuation of the McClure Hainan Island collection, purchased from Canton Christian College, China; and 627 from Hood River region, Oregon, purchased from the collector, L. F. Henderson of the University of Oregon.

The curator made several short trips to various parts of northern California in the spring and collected as follows: 64 species on a one-day trip over Mount Hamilton from San Jose to Livermore; 11 species from an early trip to Ione, Amador County; 148 species from a short trip to Madera and Raymond, Madera County; 149 species from Potter Valley, Mendocino County; and 214 from the foot of Mount Sanhedrin, Lake County. On a trip to Portland, Oregon, to attend the meeting of the Pacific Division of the American Association for the Advancement of Science, collections were made in Oregon, Washington and Idaho. At Portland, 11 species were collected, 25 on the Columbia Highway, 48 at Wind River Forestry Station, 291 at Pullman and vicinity, and 63 at mouth of the Salmon River.

Besides a number of contributors whose names will appear in the general list and whose contributions consisted of one or two specimens sent usually for identification, the following made valuable contributions to

the herbarium: W. J. Classen, Cold Bay, Alaska, 27; George Haley, from Unalaska, Unimak and St. Paul Island, Alaska, 135; William Votriede, 83, Eldorado County; Mrs. G. Earle Kelley, 29, from Round Valley, Mendocino County; A. F. Graff, 17, Cazadero, Sonoma County; W. P. Steinbeck, 15, Calaveras County; Mrs. Joseph Clemens, 23, from Texas; Cecil Hart, 23 desert plants, Southern California; Mrs. E. C. Sutliffe, 20, Marin County; Mrs. J. C. Augsbury, 17, Yosemite region; Mary E. Webb, 26, Santa Barbara; Mrs. E. C. Wright, 71, Mono Lake region; Mrs. Ilsien Nathalie Gaylord, 26 mosses from the eastern United States; F. V. Coville, 17 specimens of Ribes from California; Eric Walther, 115 specimens of cultivated plants.

The collections from the islands off the coast of Mexico made on the California Academy expedition in the spring have not yet been named or listed, but will undoubtedly add many new species to the collection as well as duplicates for exchange.

In continuation of exchange, duplicates from our herbarium have been sent to the following institutions: Arnold Arboretum, Jamaica Plain, Mass., 210; Gray Herbarium, Cambridge, Mass., 47 Lower California; Royal Herbarium, Kew, England, 133 Galapagos duplicates and 155 miscellaneous specimens; 247 miscellaneous specimens to Pomona College, Claremont, California.

Besides the regular herbarium work which takes a great deal of time in a rapidly growing herbarium, much time has been given to the identification of exotics, as the Academy is now regarded as the California authority, our collection of the exotics cultivated in California being the most complete.

Popular addresses have been given on botanical subjects, conservation of the wild flowers, and the history and botanical features of Golden Gate Park, to schools, Parent-Teachers Associations, floral societies, federation of women's clubs and individual clubs, Alpine, Sierra, and Tamalpais Conservation Club, and Girl Scouts. Two lectures have been given for the Academy and one at the Portland meeting.

The Botanical Club holds weekly meetings or excursions and has now about 75 members. A class of Park gardeners meets in the herbarium two evenings a month. This is to enable the ambitious men to learn the names and relationships of the species in the park. The exhibition of cultivated and native flowers in bloom out of doors is one of the popular features of the museum and is consulted by many people throughout the year. Hundreds of species are exhibited during the year, each labelled with scientific and common name and native home. Mrs. Johanna Wilkens keeps it clean and in order, and, without her careful attention, it would not be possible to have it always looking nice. My assistant, Mrs. George H. Phelps, does all the mounting of the rapidly increasing collection, besides many other duties such as putting the additions into their proper places in the herbarium, looking after the specimens being dried, writing labels of duplicates, besides other duties that do not require botanical knowledge.

ALICE EASTWOOD, *Curator.*

April 28, 1926

DEPARTMENT OF ENTOMOLOGY

Nineteen twenty-five was another year of active advance in the Department of Entomology. Two large collections were added to the Academy resources; specimens received from other sources number more than the average; the mounting and labelling of accumulated material made available for study much which before had potential value only, and the addition of new cases permitted the rearranging of the collections to be advanced rapidly.

Additions to the department collection during 1925, received through the ordinary activities of the department, numbered 27,301 specimens. In addition, two large collections were formally presented to the Academy which merit special mention. On August 22, Dr. F. E. Blaisdell presented to the Academy his entire collection of Coleoptera, numbering at least 100,000 specimens. These were given under the same conditions as was the Van Dyke collection presented last year, conditions that allow the donor the free use and control of the material during his life time, assures its permanent preservation, and, with the Van Dyke collection, places in the possession of the Academy a remarkably complete series of the beetles of North America, which, in the case of the western species, are represented by exceptionally large and valuable series showing geographical and ecological variation. The other collection mentioned is the curator's private collection of Hemiptera numbering perhaps 30,000 specimens. This collection, accumulated through more than 30 years of systematic work on that order of insects, represents a very large proportion of the species known from America north of Mexico up to 10 years ago, and, added to the extensive collection of western Hemiptera already in the Academy collection, forms a representation in that order of insects perhaps unsurpassed so far as our North American fauna is concerned.

Of the ordinary accessions of the year the largest item is the material taken by the curator's assistant, Mr. H. H. Keifer, on the Academy's expedition to the Revillagigedo Islands, numbering 10,753 specimens. The work of determining this material has only just begun, but undoubtedly many new and rare species will be found in it. Other notable additions during the year were: from Mr. A. J. Bassenger, 2210 specimens including a large and interesting series of Diptera from Alaska; from Mr. C. L. Fox, 3,114 specimens consisting of Diptera and Coleoptera from eastern Washington and western Idaho and a valuable series of Hymenoptera from Arizona; from Dr. E. C. Van Dyke, 1954 insects of orders other than Coleoptera from Oregon and eastern Washington and other localities; from Mr. J. C. Huguenin, 1870 miscellaneous insects; from Mr. Walter M. Giffard, 320 leaf-cutting bees from about Lake Tahoe, California; from Mr. E. A. Dodge, a collection of 478 tiger beetles made many years ago by his brother, Mr. G. M. Dodge, and including many rare species, also from Mr. Dodge a collection of 211 moths from Exeter,

California, secured by his son, the late Ralph M. Dodge; from John E. Carey, 905 Lepidoptera from Panama including many rare and beautiful forms. Other valuable donations to the department collection were made by Mr. Louis Slevin, Mr. E. R. Leach, Mr. J. O. Martin, Mr. Geo. Haley, Dr. J. A. Comstock, Mr. David M. McKell, Mr. B. H. Murray, Mr. Eric Walther, Mr. Joseph Mailliard, Mrs. H. J. Smith, Mr. Frank Mason, Mr. J. G. Grundell, and others. In addition to these donations 3800 insects were secured by the curator and his assistant in field work in the Bay region.

On January first, Mr. Hartford H. Keifer was added to the department staff as full-time assistant, and, through his continued and faithful efforts, much has been done toward mounting and labelling accumulated material. Mr. J. O. Martin completed the installation of the Holbrook collection of butterflies, which now is well displayed on specially constructed multiplex frames in the bird hall. Following the completion of the Holbrook collection, he has been working part time on the incorporation of the Van Dyke collection into that of the Academy in the new unit boxes recently adopted in this department. Over 26,000 specimens from the Van Dyke collection have been so arranged and the work is being pushed as rapidly as possible. The balance of the material taken on the Arizona expedition of 1924 has been mounted and, with the Holbrook collection, brings the total additions to this department for 1924 up to 30,700 specimens.

The Academy is under renewed obligations to Messrs. Barnes and Benjamin for the determination of moths in its collection. Through this assistance most of the moths, exclusive of the micros, are now determined and the arranging of the collection will be pushed as rapidly as boxes become available. Prof. P. A. Claassen of Cornell University has determined the stone-flies in the collection and these are now available for study. Dr. E. C. Van Dyke has devoted much time and effort during the year to checking over the Academy collection of beetles as fast as they are arranged in the unit boxes. So far, the families Cerambycidæ, Buprestidæ, Scarabiidæ, Cicindelidæ and the Cychriini have been gone over by him and are now available for the use of students of these interesting insects.

The Pan-Pacific Entomologist, initiated in 1924, has reached the middle of the second volume. This effort to give the West a place in the entomological literature of the country is meeting with much encouragement. While it is not yet self-sustaining, that goal does not seem as distant as it did, and with moderate assistance for a few years it should attain independence and show growth both in size and quality.

The growth of the Department of Entomology during recent years has been most encouraging and, with continued support, the Academy of Sciences will have a collection of insects that will rank among the largest and most valuable in the country.

EDWARD P. VAN DUZEE, *Curator*.

Department of Exhibits

So much of the time of the personnel of this department has been diverted to other matters that there is less to report as accomplished in the field of exhibits than has been the case in previous years; but, in spite of interruptions, Mr. Frank Tose, chief taxidermist and group artist of the Museum, has arranged and installed four more panel groups in the Bird and Mammal halls, all of which have attracted much favorable comment. The four groups are: California Woodpecker, Lazuli Bunting, Point Reyes Mountain Beaver, and Warner Mountain Cony. The California Woodpecker Group is especially interesting in that it shows the combination of a nesting hole and a tree that is thickly inset with acorns, well exemplifying the characteristic storage habit of this bird. The Mountain Beaver and the Cony groups exhibit two species of small mammals so rarely seen by the public that the majority of people do not even know of their existence.

The rearranging of the Grizzly Bear Group, which was commenced late in the fall of 1924, extended well into January, 1925. In the early spring a number of birds were collected and mounted in preparation for that time when the proposed seasonal groups of the birds of Golden Gate Park become realities. In between times some fine work was done on wax reproductions of beautiful Colorado Desert cacti, to be installed in the present desert group to make it even more attractive.

A matter that occupied several weeks of departmental time was the construction and the placing in position for future use of cases for panel groups in all available spaces in order to save the time and labor involved by the old method of setting in position cases for each group as needed. The backs of these newly installed cases and the backs of all those already arranged with groups have have been so treated as to make them harmonize with the backgrounds and accessories of the large habitat groups into which they project. The camouflaging of these projecting backs has greatly improved the appearance of the large groups and added to their charm.

Mr. Tose was detailed, with Mr. J. T. Wright as assistant, to represent the departments of Ornithology and Mammalogy on the expedition that started about the middle of April to the Revillagigedo and Tres Marias islands and returned toward the end of June. The preparation of equipment before starting and the finishing up of the temporarily prepared and cold storage specimens obtained on this expedition, with the voyage itself, occupied these members of the department from the first of April until well into July.

Later in the year, practically a month was occupied by Mr. Tose in making from a cast a life-sized model of a great Leatherback Turtle for the Department of Herpetology.

While the demand for portable school groups does not seem to have lessened, there has been no time available, with the present force, for the construction of new ones, and the only work carried on in this line has been the reconstruction of some that had been damaged by accidents. The portable school groups now in use consist of one each of the following: Sandpipers and marsh birds, California Woodpecker, Gila Woodpecker, Barn Owl, Western Meadowlark, California Shrike, San Francisco Towhee, Western Robin, Sierra Golden-mantled Ground Squirrel, California Ground Squirrel, Sierra Chickaree, Redwood Weasel, and Spiny Pocket Mouse.

Student assistants in this department have been as follows: James F. Campbell, for the greater part of the year; Miss A. M. Hill, short course in accessory work; J. T. Wright, first half of year; Russel Hendricks and Cecil Tose, part time; and several school boys at various periods.

JOSEPH MAILLIARD, *Curator.*

DEPARTMENT OF FISHES

This Department was established August 29, 1925, at which time Mr. H. Walton Clark was made assistant curator. Mr. Clark had been a scientific assistant in the United States Bureau of Fisheries for many years, during which he was chiefly engaged in biological investigations relating to fishes and the fisheries and in studies of the geographic distribution of fishes. When the Steinhart Aquarium was established in 1923 Mr. Clark was made chief collector, which position he held until transferred to his present position.

The establishment of a department of fishes seemed necessary in order that proper attention might be given to systematic and life-history studies of the fishes of California and elsewhere in connection with the Aquarium and the Museum. Considerable collections of fishes have already been acquired, the principal regions represented being California, the Hawaiian Islands, China, and the Revillagigedo and Tres Marias islands off the Pacific coast of Mexico. These will all be studied, carefully identified and put in order as rapidly as possible.

It is the intention to install in the Aquarium laboratories a carefully identified reference series of specimens in alcohol of all the species of fishes of California, both fresh and salt water, and, as time and opportunity permit, similar series of the species found in the other Pacific coast states. Teachers, anglers and others often come to the Aquarium or the Museum and make inquiry about some fish they have seen but which they do not find in the Aquarium. It is hoped that when our reference series has been established, we shall be able to show to such inquirers a specimen of any species of fish about which they ask.

During the year Mr. Clark has devoted most of his time assisting Dr. Jordan and the Curator with the preparation of a revised check-list of

the fishes of North and Middle America, upon which they have been engaged for several years. He and the Curator also have in preparation a distributional check-list of the freshwater fishes of California which they hope to complete in the near future. They are also engaged in preparing a report on the fishes of the *Ortolan* expedition of 1925 to the Revillagigedo, Tres Marias, and other islands off the Pacific Coast of Mexico.

BARTON WARREN EVERMANN, *Curator.*

DEPARTMENT OF HERPETOLOGY

At the beginning of the year 1925 the Academy's collection of reptiles and amphibians numbered 56,033 specimens. There have been added during the year 3,253 specimens, so that the collection has grown to 59,286 specimens.

Gifts of specimens during the year have been received as follows: From Steinhart Aquarium, 3 specimens; J. Labarthe, 1; Prof. W. B. Herms, 37; Fred. Howarth, 11; Dr. E. C. Van Dyke, 15; H. W. Clark, 1; E. W. Williman, 3; Melbourne Ward, 5; L. M. Klauber, 145; and Miss M. E. McLellan, 8

Specimens have been secured from 5 counties of California as follows: Imperial, 4; Plumas, 6; San Diego, 136; San Francisco, 1; and San Mateo, 3.

Specimens from other localities are: Nevada, 1; New York, 11; Oregon, 1; Virginia, 3; Washington, 11; Eastern Asia, 14; Africa, 14; Australia, 5; Fanning Island, 37; Mexico, 2997; Ecuador, 1; Peru, 6; and Costa Rica, 2.

Work has been begun, and considerable progress made, on an account of the amphibians of the western portion of our continent, to complete the review of the herpetology begun by the late Dr. Van Denburgh.

Mr. Frank Tose, of the Department of Exhibits, has completed the casting of the large leather-back turtle presented to the Academy by the San Francisco International Fish Company.

The classification, labeling, cataloging, and arrangement of the collection was continued during the year.

Field work was carried on in Mexico. The expedition to the Revillagigedo Islands resulted in a collection of 1,550 specimens, and the continuation of the field work in the states of Oaxaca, Vera Cruz, Tehauntepec, and the Federal District of Mexico in 1,438 specimens.

The thanks of the department are due Profs. Herrera, Solis, and Contreras, of Mexico City, and Mr. Paul Ruthling, of Cosolapa, for the many courtesies extended.

JOSEPH R. SLEVIN, *Assistant Curator.*

Library

During the year 1925 the library of the Academy maintained a steady and satisfactory growth in all departments of its work. The accessions numbered 967 complete volumes, of which 336 were added by purchase, 239 by gift, and 492 by the completion of volumes through material received in exchange. In addition to these the usual number of serial publications were received by exchange. Most of these exchanges were publications of scientific societies and will be included in completed volumes later. A number of valuable donations to the library were received during the year, but none of exceptional extent, although among them were a few that made most welcome additions to the library resources of the Academy.

Miss Margaret Dold severed her connection with the library on May 25, and for some time the library was without an attendant. On September first Mr. C. A. Bellas entered upon the duties of assistant in the library and, by faithful work, has gotten the the accumulated material assorted and properly shelved. He has also entered on the accessions register all complete volumes received and has classified and catalogued certain books requiring such attention. He has also done much toward bringing up to date certain of the foreign exchanges that had gotten behind during the war conditions.

Another item of much interest in the library work was the binding of 1183 volumes. For a number of years no binding had been done, so there was a large accumulation of unbound material. Such unbound volumes are awkward to handle and are subject to rapid deterioration in use, so the binding of so many volumes was an improvement in the library service that has been very much appreciated by the library staff. A minor convenience to all users of the library was the construction of a small case near a window for shelving the Zoological Record, so those most indispensable helps can now be referred to without the inconvenience of stack use.

On the whole, the library has made a most satisfactory growth in its resources and in its use both by the staff and by outside members, and the outlook for the coming year is most encouraging.

Edward P. Van Duzee, *Assistant Librarian.*

Department of Mammalogy

As has been customary for the past few years, work in this department has been carried on in connection with that of the Department of Ornithology, and there has been but little attempted that was particularly distinctive.

Limited collections of the smaller mammals have been made by the Curator and his assistants in Modoc, Siskiyou, and Placer counties, California, and in the extreme southern part of Josephine County, Oregon;

by Mr. Frank Tose, of the Department of Exhibits, and his assistant, Mr. J. T. Wright, at various points visited by the Revillagigedo and Tres Marias Expedition; and by Miss M. E. McLellan, Assistant Curator of the Department of Ornithology, in the provinces of Sinaloa and Nayarit, Mexico.

Through the courtesy of the California Sea Products Company, Dr. E. T. Engle, who had placed his services for a limited period at the disposal of the Academy, obtained at the Trinidad Whaling Station, Humboldt County, California, some valuable osteological specimens of Cetacea and some interesting data, for this department.

The principal features of the indoor work of the department in the past year have been the construction of a new hide room and the installation in it of the collection of hides of marine mammals; the transfer of the skins of the smaller mammals from the large hide room to the standard metal cases in the mammal room, wherein several new cases have been placed; the tanning of what hides were still awaiting treatment and the rearrangement of the osteological collection.

Accessions to this department have been as follows: *By exploration:* 127 specimens. *By gift:* C. W. Bowman, 3; California State Bureau of Animal Industry, 1; Mrs. F. Ellsworth, 1; Russel Hendricks, 1; E. R. Leach, 1; A. K. Macomber, 1; John McLaren, 3; W. M. Phillips, 1; Steinhart Aquarium, 1; Mrs. Peter Swartz, 1; E. P. Van Duzee, 2; J. T. Wright, 4. *By purchase:* 2 speciments.

JOSEPH MAILLIARD, *Curator.*

DEPARTMENT OF ORNITHOLOGY

Early in the year the Mailliard oölogical and ornithological collections (with the exception of a small portion temporarily reserved, consisting of a minimum representation of all species of birds and eggs included in it) were transferred from the residence of Mr. John W. Mailliard to the Museum of the California Academy of Sciences and installed there, for the time being as separate units.

This addition to the collections, together with the John Van Denburgh collection of eggs (received in 1924, through Mr. Douglas Van Denburgh), which has been properly boxed and made ready for incorporation in the collections, and the increase in the number of specimens through field work, necessitating the installation of eleven new cases, has resulted in the filling of all the space available in the three rooms allotted to the department. Within a short time, provision will have to be made whereby the department may have additional room to house the rapidly growing collections.

The addition of the new cases made necessary a rearrangement of the whole collection. This work has been carried on by Assistant Curator M. E. McLellan, as time could be spared from other duties, but it is not yet completed.

In the absence of a regular librarian, Miss McLellan, being familiar with the work, devoted time for the space of three months to library affairs needing immediate attention, which, in consequence, curtailed the amount of work that could be accomplished in this department.

Expeditions and field work occupied a considerable portion of the year. In cooperation with the other departments of the Museum, this department participated in the Academy's expedition to the Revillagigedo and Tres Marias islands off the Mexican coast, as mentioned in the annual report of the President of the Academy. On this occasion the departments of Ornithology and Mammalogy were represented by Mr. Frank Tose, chief taxidermist of the Museum, and Mr. J. T. Wright, student and part-time assistant in the Department of Exhibits. A good collection of birds was made and some especially interesting material was obtained on this expedition.

In Siskiyou County, California, the valley of the Klamath River, from the vicinity of Hornbrook to Happy Camp and Indian Creek, some 50 miles west of Hornbrook, together with parts of Josephine County, Oregon, adjacent to the California line, was the scene of field activities from May 9 to June 13, the field party consisting of the curator, James F. Campbell, student assistant, and Raleigh Borell, general assistant. Field work was also carried on by the Curator and Raleigh Borell in Placer County, California, from June 28 to July 10.

With John Denver as general assistant, the Curator carried on field work at Eagleville, Modoc County, California, from September 8 to October 15, for the purpose of comparing the bird life found there in a normal autumn season like that of 1925 with that found in the previous year, which was the third and worst year of a prolonged drouth. One of the principal features of the work in 1925 at Eagleville was the trapping and banding of nearly 400 Gambel's Sparrows on their southward migration. This was done in the hope that some of the birds might fall into the hands of other bird banders or of people along the line of flight who might be sufficiently interested to send the band, if taken from a dead bird, or to report the band number, if found on a captured bird, to the U. S. Biological Survey, Washington, D. C., and thus add to our rather limited knowledge of the migratory movements of birds.

The last two weeks of December were occupied by the Curator, with Raleigh Borell as assistant, in investigating the winter bird life in parts of Placer County, California, and in doing some further work in bird banding.

On September 5, Miss McLellan started upon a trip to the states of Sinaloa and Nayarit, Mexico, for the purpose of securing specimens of birds from the mainland for comparison with those obtained on the Tres Marias by the departmental representatives in the spring. Work was begun about the middle of September and carried on for a period of six weeks at Labrados (near Mazatlan), San Blas, and Maria Madre Island.

The results of this trip were very satisfactory, not only because of the number of specimens secured, but also on account of the comparatively large number of species represented among them, and the obtaining on Maria Madre of representatives of several species not previously recorded from the Tres Marias.

During the year the library of this department has obtained certain valuable works, notably, Gray's *Genera of Birds, Stray Feathers,* Latham's *General Synopsis of Birds,* and Rowley's *Ornithological Miscellany,* and provision has been made for still further additions.

In the latter part of the year the purchase of a suitable automobile for the joint use of the departments of Ornithology and Paleontology was decided upon, as these departments can so coördinate their field work as not to interfere seriously with each other in regard to the date and period of use.

Accessions to the department have been as follows: Bird skins—*By exploration:* 1373 specimens. *By gift:* E. W. Gifford, 1; E. C. Johnson, 1; G. L. Merguire, 1; Nick Mouzin (for Charles White), 1; J. W. Steinbeck, 3; J. T. Wright, 94. *By purchase:* 6 specimens.

Birds' nests and eggs have been received as follows: *By exploration:* 59 sets (78 eggs). *By gift:* E. W. Gifford, 1 egg; Mrs. Lloyd H. Robbins, 1 nest.

JOSEPH MAILLIARD, *Curator.*

DEPARTMENT OF PALEONTOLOGY

During 1925 several considerable and noteworthy collections came to the Department of Paleontology. Dr. Roy E. Dickerson, formerly Curator, presented a large collection of invertebrate fossils from the Philippine Islands, Java and Japan.

After several months of exploration in the bone beds of Shark-Tooth Hill, Kern County, California, under the direction of Charles Morrice, work there was suspended early in the year. The material collected was transmitted to Dr. Remington Kellogg, U. S. Biological Survey, Washington, D. C., for study and report, and, although a great many valuable additions to vertebrate paleontology have been made at that locality, it seems probable that a better site for a quarry may be found in the vicinity. In the excavations thus far explored the bones of the animals are scattered and broken although they are present in almost unbelievable abundance.

In April, the Curator and Assistant Curator left San Francisco on the U. S. S. *Ortolan,* as members of the Revillagigedo Islands Expedition. Almost two months were spent in the field. Collections were made of fishes, marine invertebrates, fossils, rocks, and living marine and land mollusks. Formal reports will be prepared on these various groups and they will give a better indication of the character of the collections than a preliminary announcement. However, it should be explained at this

point that the giving of figures to represent numbers of specimens in this department is impracticable. For instance, a single cubic inch of some of the samples of organic shales collected can be shown to contain more than a hundred million individual skeletons of organisms.

One other accession worthy of note is the large collection of samples of sedimentary rocks and shales obtained in drilling oil wells by the Pacific and Associated Oil Companies. It is impossible to estimate the scientific value of this collection and it is the only one of its kind of any consequence in existence in any museum. It would cost many millions of dollars in drilling expense to duplicate the collection. On account of lack of storage space in the laboratory and the large size of this collection, it has been necessary to house it in the basement of the Museum building, but there it has been systematically arranged so that any part is readily accessible.

The bulk of the detailed work of the Department during this year has fallen upon Mr. Eric Knight Jordan, Assistant Curator, and Mr. Leo G. Hertlein, Temporary Assistant. Their duties have been faithfully and efficiently performed, and this is reflected in the fact that the collections of the Department have probably never before been so well kept or so orderly arranged.

Various institutions and individuals have made use of the collections of the Department and at the end of the year the outstanding loans were as follows: Dr. Paul Bartsch, U. S. National Museum, Washington, D. C.; Miss Mary J. Rathbun, U. S. National Museum, Washington, D. C.; Dr. W. P. Woodring (Feb. 12, 1926), U. S. Geological Survey, Washington, D. C.; Dr. Wm. H. Dall, U. S. National Museum, Washington, D. C.; Dr. Fred Baker, Point Loma, California.

G. DALLAS HANNA, *Curator.*

STEINHART AQUARIUM

It is a pleasure to report the Aquarium in good condition and the most popular public institution in San Francisco. The attendance for the year was 1,043,591. Our attendance on Sundays and holidays is still too large for seeing the fishes to the best advantage and is a constantly repeated argument for additional room that a new wing would provide.

The total number of live specimens in the Aquarium tanks on Dec. 31, 1925, was 7,120, an increase of 912 during the year. These are divided among the branches of the animal kingdom as follows:

Mammals	**8 specimens**	**4 species**
Birds	**1 specimen**	**1 species**
Reptiles	**75 specimens**	**22 species**
Batrachians	**13 specimens**	**7 species**
Fishes	**6596 specimens**	**201 species**
Invertebrates	**427 specimens**	**6 species**
Total	**7120 specimens**	**240 species**

The above is exclusive of the Hatchery in which 8,000 eggs of Trout and Salmon were hatched during the year.

It would seem a far cry from the slimy Hagfish in tank No. 9 to the study of Pyorrhea. However, one of the activities of the Aquarium during the past year was to supply quantities of mucous from these fish to Dr. R. N. Loomis of the University of California Dental College in order that the effects of mucous on dentin might be carefully studied and its relation to disease, if any, established.

One would not really suspect the Aquarium to have any connection whatever with the 18th amendment, yet a special investigator, Dr. McCay of the California State Fish and Game Commission, spent a month in our Laboratory investigating the pollution of the San Francisco Bay water by a large distillery and the effect of the same on our commercial fishes.

Dr. Shaw, of Shanghai, China, and Dr. Deogracis Villadolid, from the Philippine Islands, have spent considerable time on the study of our collections.

The State Board of Health of Sacramento keeps one of our large tanks well stocked with mosquito fish *(Gambusia affinis)*, and has requested us to distribute these fishes free of charge to anyone desiring small fish for stocking ponds, garden pools and aquariums. Several hundred of these have been so distributed and will no doubt assist in the abatement of the mosquito pest in this state. On Nov. 2, 1925, a shipment of these fish was sent to Tahiti, Society Islands, to help to eliminate the mosquitos.

The gifts of live animals to the Aquarium during the year number 726. Eight of these were alligators.

Our loss of specimens during the year has not been excessive. We have had no bad epidemics; as a matter of fact, we have been assured on very good authority, our loss has been considerably less than at other large aquariums.

We have been fortunate in securing the services of Mr. Robert J. Lanier, formerly of the New York Aquarium, whose long experience in that aquarium wil be of benefit to us.

Mr. H. Walton Clark was transferred from the Aquarium staff on Sept. 14 to the position of Assistant Curator of fishes in the California Academy of Sciences.

On March 20, our collector, W. J. Martin, resigned and his place was taken by Mr. Herbert Brandt.

With the exceptions noted above and a few minor changes, the staff of the Aquarium remains the same.

It is the desire of the Superintendent that the Aquarium may continue to improve during the coming year. As a means to that end we respectfully suggest that a small greenhouse for growing of tropical plants and fishes be constructed on the roof of the Aquarium, and the matter of securing more warm water tanks seriously be considered. Also that arrangements be made to secure a large number of the beautifully colored fishes found along the shores of Mexico and Central America.

During the year, 728 gifts of living animals, chiefly fishes and reptiles, were made to the Aquarium. To the many donors our grateful appreciation is hereby expressed.

During the same period the Academy, on behalf of the Aquarium, supplied a total of 1858 specimens of live fishes and other small aquatic animals to schools and individuals for use in small balanced aquariums in schools and homes. In this way and through definite instruction we are doing much to encourage the establishment and maintenance of these really educative adjuncts to schools and homes.

The number of schools visiting the Aquarium continues to grow, as shown by the following summary:

SCHOOLS VISITING THE AQUARIUM

Schools of San Francisco		
Total Number Visiting Pupils.........	8090	8090
Total Number Visiting Teachers.......	285	
Total Number Visiting Classes.........	299	
Schools Outside of San Francisco		
Total Number of Pupils...............	1776	1776
Total Number of Teachers............	65	
Total Number of Classes..............	83	
		9866

ALVIN SEALE, *Superintendent.*

ACCESSIONS TO MUSEUM AND LIBRARY FOR 1925

Alaska Packers Association, San Francisco: 10 specimens of *Cardium corbis* from Alaska. Gift.

Aldous, Harry, 228 West First North Street, Salt Lake City, Utah: 19 sets of bird eggs (80 eggs). Exchange.

Anderson, Mrs. W. F., Indio, Calif.: 3 botanical specimens from Indio, Calif. Gift.

Andrews, C. L., Point Barrows, Alaska: 2 mammal skins and 6 bird skins from Alaska. Purchase.

Associated Oil Co., 79 New Montgomery Street, San Francisco: 4 specimens of cretaceous mollusks from Oregon and British Columbia, 50 samples of fossiliferous cretaceous shales from Moreno Gulch, Fresno Co., Calif., a slab of freshwater Ostracod Shale from Brazil, and 15 specimens of Pliocene fossils from near Casmalia, California. Gift.

Augsbury, Mrs. J. C., 1300 Balboa Street, San Francisco, Calif.: 17 botanical specimens from Yosemite, Calif. Gift.

Bailey, H. H., Miami, Florida: 1 pair Florida Screech Owl, 2 pairs Florida Bob White, 2 pairs Cardinal, 4 pairs Bahama Redwing, 2 male Least Tern, 1 female Dusky Seaside Sparrow, 2 male Loggerhead Shrike, and 1 male Southern Meadowlark. Exchange.

Baker, Dr. Fred, Point Loma, Calif.: 36 species of mollusks new to Academy collection. Exchange.

Baker, Dr. Fred, Point Loma, Calif.: 9 lots of freshwater mollusks. Gift.

Baldwin, Mrs. Elizabeth R., San Luis Obispo, Calif.: 2 specimens of plants from San Luis Obispo, Calif. Gift.

Bassenger, A. J., Citrus Experiment Station, Riverside, Calif.: 2210 insects, largely from Alaska and including a fine series of Alaskan Diptera. Gift.

Blaisdell, Dr. F. E., 1520 Lake Street, San Francisco, Calif.: 50 insects, mostly Cicadas, from Yreka, Calif. Gift.

Blaisdell, Dr. Frank E., Sr., 1520 Lake Street, San Francisco, Calif.: The Blaisdell Collection of Coleoptera, of about 100,000 specimens. Gift.

Bottom, Charles, 1316 W Street, Sacramento, Calif.: 44 mounted birds from California. Gift.

Bowman, C. W., 2032 Judah Street, San Francisco: 1 boar's tusk from the Philippines, 2 boars' tusks from Lake County, Calif. Gift.

British Museum, London, England: 14 specimens of reptiles and amphibians from Eastern Asia. Exchange.

Bureau of Animal Industry, San Francisco, Calif.: 1 *Antilope cervicapra,* in flesh, from Australia. Gift.

Canton Christian College, Canton, China: 125 specimens of the McClure collection of Hainan plants. Purchase.

Carey, John E., Manila, P. I.: 905 specimens of Lepidoptera from Panama. Gift.

Charles, Juanita E., Cazadero, Calif.: 1 botanical specimen from Cazadero, Calif. Gift.

Christensen, Mrs. C. P., 1260 9th Avenue, San Francisco: 1 lot of miscellaneous minerals. Gift.

Classen, W. J., Menlo Park, Calif.: 27 botanical specimens from Alaska. Gift.

Clark, Mrs. Curran (Cora Taylor Clark), 1502 Willard Street, San Francisco: 1 oil painting of John Taylor, former Trustee of the California Academy of Sciences. Gift.

Clark, H. Walton, San Francisco, Calif.: 1 lizard from San Francisco, Calif., and 1 botanical specimen from California. Gift.

Clemens, Mrs. Joseph, 638 Isaac Peral, Manila, P. I.: 23 specimens of plants from Texas. Gift.

Coale, H. K., 528 S. Linden Avenue, Highland Park, Ill.: 1 female White-wing Junco, 1 male Fish Crow, 1 pair Florida Redwing, 1 female Vera Cruz Redwing, 1 pair Southern Downy Woodpecker, 1 pair Southern Meadow Lark, 1 pair American Goldfinch, 1 female Rock Sparrow, 1 female Dakota Song Sparrow, 1 male Warbling Vireo, 1 male White-eyed Vireo, 1 male Swainson's Warbler, 1 female Texas Wren, 1 male Prairie Marsh Wren, 1 pair House Wren, 1 pair Willow Thrush. Exchange.

Comstock, Dr. John A., Southwest Museum, Los Angeles, Calif.: 66 Butterflies, new to the Academy Collection. Gift.

Contreras, Prof. Francisco, Museo Nacional de Historia Natural, Mexico, D. F.: 20 miscellaneous pamphlets. Gift.

Coville, Dr. F. V., National Herbarium, Washington, D. C.: 17 specimens of Ribes from California. Gift.

Dickerson, Dr. Roy E., Standard Oil Co., San Francisco: A large collection of fossils from the Philippine Islands. Gift.

Dodge, E. A., 546 Bay Street, Santa Cruz, Calif.: 201 miscellaneous insects, largely moths, taken by Ralph Dodge at Exeter, Calif. Gift. 478 tiger-beetles forming the G. M. Dodge Collection of Cicindelidæ. Gift.

Doods, Clifford, R. D. No. 2, Ojai Road, Santa Paula, Calif.: 169 insects from various localities. Gift.

Ducruet, Theo. I., 2964 Pine Street, San Francisco: 3 mussel shells from Visitacion Valley, San Francisco Bay. Gift.

Durbrow, Mrs. Pierson, 62 5th Avenue, San Francisco, Calif.; 1 botanical specimen from California. Gift.

Eastwood, Miss Alice, California Academy of Sciences, San Francisco: 30 specimens of land mollusks from Bakers Point, Idaho. Gift.

Eastwood, Miss Alice, California Academy of Sciences, San Francisco: 223 California plants.; 834 botanical specimens as follows: 33 from Marin County, Calif.; 214 from Lake County, Calif.; 149 Mendocino County, Calif.; 11 from Portland, Oregon; 25 from Columbia Highway, Oregon; 48 from Wind River Forest Station, Washington; 242 from Pullman, Washington; 49 Moscow and Lewiston, Idaho; 63 from mouth of Salmon River; 6 botanical specimens from Marin County, Calif. Exploration.

Ellsworth, Mrs. F., 917 Sierra Street, Turlock, Calif.: 1 *Mycteris cinerea*, in flesh, from Stanislaus Co., Calif. Gift.

Elms, Mrs. Ida B., 853 W 58th Place, Los Angeles, Calif.: 1 specimen of plant from Los Angeles, Calif. Gift.

Evermann, Dr. Barton W., California Academy of Sciences, San Francisco: The Catalina Islander, Vol. XI, Nos. 2-14, 16-33, 35-47, 49-52. Vol. XII, Nos. 1-7, 9-14, 16-24, 26-30. Gift.

Fox, Chas. L., 1621 Vallejo Street, San Francisco, Calif.: 1122 insects, mostly Diptera and Coleoptera, taken in Washington and Idaho. Gift. 1982 Hymenoptera collected by Mr. Poling in Arizona. Gift.

Friersen, L. S. Jr., Gayle, Louisiana: 1 snake from Louisiana. Exchange.

Frye, Dr. T. C., State University, Seattle, Washington: 2 specimens of mosses from Friday Harbor, Washington. Gift.

Gaylord, Mrs. Llsien Nathalie, Hotel Graylyn, 20 Charlesgate, W. Boston, Mass.: 46 specimens of mosses from the Atlantic Coast and the eastern states. Gift.

Giffard, Wm. M., Honolulu, T. H.: 320 bees of the family Megachilidæ (mostly Osmias) from Tahoe region, Calif. Gift.

Gifford, E. W., Museum of Anthropology, Affiliated Colleges, San Francisco: 1 *Gallicolumba rubescens*, in flesh, Aviary specimen, native of Marquisas Islands.

Graff, A. J., Cazadero, Calif.: 17 specimens of plants from Cazadero, Calif. Gift.

Gram, E., Cisco, Placer County, Calif.: 1 *Orcortyx picta plumifera*, in flesh, from Placer County, Calif. Gift.

Griffin, Alice., El Verano, Calif.: 6 botanical specimens from Sonoma County, Calif. Gift.

Grundell, J. G., Oakdale, Calif.: 77 insects taken at Cuero, Texas.

Grunsky, C. E., Mechanics' Institute Bldg., San Francisco: 2 pamphlets (Collection Ant. W. M. Mensing, Amsterdam: Old Scientific Instruments 1479-1800, text and plates. Gift.

Hack, Prof. Ingo, College of Physicians and Surgeons, 344 14th Street, San Francisco: 1 Gila Monster collected near Casa Grande, Arizona, by G. S. Woods of Casa Grande, Arizona. Gift.

Hale, Albert, Tacoma, Washington: 1 fossil shell from Vader, Washington. Gift.

Haley, George, 2311 Bancroft Way, Berkeley, Calif.: 56 specimens (botanical) and 10 insects from St. Paul Island. Gift.

Hanna, G. Dallas, California Academy of Sciences, San Francisco: 1 lot of fossil fishes from near Arroyo Grande, Calif., and 47 miscellaneous pamphlets. Gift.

Hanna, Marcus A., Gulf Production Co., Houston, Texas: 20 lots of foraminifera and small mollusca from Texas, Alabama and Louisiana. Gift.

Hardman, Gertrude R., Tomales, Calif.: 4 specimens of plants from Sonoma County, Calif. Gift.

Hart, Cecil., Route 2, Box 432, Los Angeles, Calif.: 23 botanical specimens from Southern California. Gift.

Henderson, L. F., Hood River, Oregon: 627 plants from the Hood River Valley, Oregon. Purchase.

Hendricks, Russel, 1166 Guerrero Street, San Francisco: 1 *Scapanus latimanus latimanus,* from Golden Gate Park, San Francisco. Gift.

Henry Sotheren & Co., London, England: 1 book (van Heurck, The Microscope). Purchase.

Herms, Prof. W. B., University of California, Berkeley, Calif.: 37 lizards from Fanning Island. Gift.

Holmes Book Company, The, San Francisco, Calif.: 4 books: Barrows—Voyages of Discovery, etc.; Payer—New Lands within the Arctic Circle; Atkinson—Oriental and Western Siberia; Davis—Narrative of the North Pole Expedition, "Polaris". Purchase.

Houghton, Mifflin Company, San Francisco, Calif.: Complete works of John Muir (10 volumes). Purchase.

Howarth, Fred J., Raton, New Mexico: 5 snakes and 6 lizards from New Mexico. Gift.

Hudson, Dr. J. W., Ukiah, Calif.: 6 botanical specimens from Ukiah, Calif. Gift.

Huguenin, J. C., 1810 15th Street, San Francisco, Calif.: 1870 insects, largely from California. Gift.

Hunt, C. L., 212 4th Street, Marysvile, Calif.: 1 "Mill Pick" from the old Buckeye Mill at Marysville, Calif. Gift.

Johnson, E. C., Bureau of Fisheries, L. C. Smith Bldg., Seattle, Washington: 1 *Riparia riparia,* in alcohol, from the Pribilof Islands. Gift.

Keifer, H. H., California Academy of Sciences, San Francisco, Calif.: 10,753 insects from Revillagigedo Islands, and 1290 insects, mostly micro-lepidoptera, taken about San Francisco. Exploration.

Kelly, Mrs. G. Earl, 1311 Grand Street, Alameda, Calif.: 28 specimens of Oregon plants. Gift.

Klauber, L. M., San Diego, Calif.: 25 herpetological specimens from San Diego, and 29 snakes, 99 lizards, 10 frogs, 4 salamanders from San Diego and Imperial counties, 2 snakes from Washington, 1 lizard from Oregon. Gift.

Koelz, Prof. Walter, University of Michigan, Ann Arbor, Mich.: 1 pair Mandt's Guillemot, 1 pair Iceland Gull, 1 pair Florida Cormorant, 1 pair Northern Eider, 1 pair Greater Snow Goose, 1 pair Florida Clapper Rail, 1 pair Florida Screech Owl, 1 Black-headed Jay, 1 Labrador Jay, 1 pair Florida Grackle, 1 pair Greater Ridpoll, 1 Migrant Shrike, 1 male Fish Crow. Exchange.

Koeltz, Walter, Dept. of Zoology, University of Michigan, Ann Arbor, Michigan: 8 specimens of birds. Exchange.

Kusche, J. August: 22 insects from California. Gift.

Labarthe, Jules, Berkeley, Calif.: 1 lizard from Nevada. Gift.

Larson, A. C., Alhambra, Calif.: 42 beetles from California. Gift.

April 28, 1926

Lastreto, C. B., 260 California Street, San Francisco: The Periscope, V. I, No. 9; The China Journal (of Arts and Sciences), V. II, No. 3; Mid-Pacific Magazine, V. 29, No. 3; Proc. of the Pan-Pacific Food Conservation Congress; Bull. of the Pan-Pacific Union. N. Ser. No. 63, 64; Haldeman-Julius Monthly, Sept., Oct. 1925; The Auk, V. 39, No. 4; 40, No. 2-4; 42, No. 1-4; The Condor, V. 24, No. 3-4; 25, No. 5; 24, No. 3-4; 27, No. 1-6; Calif. Acad. Sciences Proc., 4th Ser. T. pp. & Ind. to Vol. XI, Vol. XII, Nos. 6, 23, 24, 29, 32-33; Vol. XIII, Nos. 3, 5, 27-28; Vol. XIV, Nos. 1-11, 14-17; 19 copies of "The Scientific Monthly"—11 copies of 1924, 8 copies of 1925. Gift.

Leach, E. R., 217 Hillside Ave., Piedmont, Calif.: 84 insects from California, and 1 *Nycteris borealis teliotis* from Alameda Co., Calif. Gift.

Mackay, Mrs., 166 Saturn Street, San Francisco: 2 turtle shells from the Galapagos Islands, and 1 box of miscellaneous shells and corals from various parts of the world. Gift.

Macomber, A. K., Burlingame, Calif.: 1 set of antlers of *Cervus schomburgki*. Gift.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 104 bird skins, 38 mammal skins and skulls, and 1 head of Redhead Duck from Modoc County, Calif. Exploration.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 10 mammal skins and skulls from Placer County, Calif.; 136 bird skins from Placer County, Calif.; 9 mammal and 30 bird skins from Siskiyou County, Calif.; 29 mammal skins and skulls from Josephine Co., Oregon; 9 mammal skins from Josephine Co., Oregon; 69 bird skins from Josephine Co., Oregon. Exploration.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 111 bird skins; 5 mammal skins and skulls; 3 mammal skins; from Siskiyou County, Calif. Gift.

Mailliard, Joseph, California Academy of Sciences, San Francisco: Two lots of freshwater mollusks Gift.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 16 land and freshwater shells from Siskiyou Co., Calif.; set of 14 photographs showing cutting and preparing the Big Tree (Sequoia gigantea), "General Noble", for shipment to the World's Fair, Chicago, in 1893. The tree grew in Fresno Co., Calif. A collection of fossil shells from the Cretaceous near Hornbrook, Calif., and 80 Moths taken in Modoc Co., Calif. Gift.

Martin, J. O., 2826 Kelsey Street, Berkeley, Calif.: 95 insects, mostly from Del Norte Co., Calif., and 2 land shells from Arcata, Humboldt Co., Calif. Gift.

Mason, Frank, 5533 Pulaski Avenue, Germantown, Philadelphia, Pa.: 78 Hemiptera, mostly from Africa and India. Gift.

Mayer, Mrs. L., 849 Fulton Street, San Francisco: A miscellaneous collection of minerals, shells, etc.; Alaska garnets; black mica, Black Hills, D. T.; Tennessee marble, Madison, Indiana, Marble Works, March 14, 1883; Indian spear head, Eagle Hollow, Oliva River, Madison, Indiana, March 14, 1883; Toy monument made of U. S. greenbacks redeemed and macerated, at the U. S. Treasury, estimated at $5,000, manufactured 715 14th Street, N. W., Washington, D. C.; 1 pair toy Eskimo boots, Eskimo Village Mid-Winter Fair, Labrador natives, April 21, 1894, 35 unlabeled minerals, Indian spear heads, etc.; 300 shells, pebbles and miscellaneous objects of various sorts. Gift.

McAllister, M. Hall, San Francisco: Proceedings of Calif. Acad. Sci., 4th Series, Vol. XIV, Nos. 7, 8, 9, 11, 13, 14, 15.

McDonald Miss Julia, 1221 Lombard Street, San Francisco, Calif.: 19 specimens of California plants. Gift.

McKell, David, Foxcroft Bldg., San Francisco, Calif.: 141 insects, mostly butterflies, from Panama. Gift.

McLaren, John, Golden Gate Park, San Francisco: 1 adult Black Bear (male) (skin); 1 raccoon (male); 1 kangaroo, in flesh; 1 *Bison bison* subsp., in flesh, from Golden Gate Park. Gift.

McLellan, Miss M. E., California Academy of Sciences, San Francisco: 115 bird skins from Sinaloa and Nayarit, Mexico; 1 mammal skin and skull from Sinaloa, Mexico; 3 mammal skulls from Nayarit, Mexico; 79 bird skins from Sinaloa, Mexico; 100 bird skins from Sinaloa, Nayarit and Maria Madre Island, Mexico; 4 snakes, 3 lizards, 1 toad from Sinaloa, Mexico; 3 mammal skins from Sinaloa and Nayarit, Mexico; 29 bird skins from Nayarit, Mexico. Exploration.

Merguire, G. L., 940 Oak Street, San Francisco: 1 Golden Eagle (mounted) taken one mile back of Stanford University, Calif., in 1902 by Loring Merguire and John Meares. Gift.

Michael, Mrs. Enid, Yosemite, Calif.: 1 botanical specimen from California. Gift.

Mitchell, Mrs. H., 1205 Hyde Street, San Francisco, Calif.: 2 specimens of California plants. Gift.

Mouzin, Nick (for Charles White), Conservatory, Golden Gate Park, San Francisco: 1 *Lophodytes cucullatus*, in flesh, from Marin County. Gift.

Murray, R. H., San Mateo, Calif.: 63 insects from Beresford, San Mateo Co., Calif. Gift.

Museum of Comparative Zoology, Cambridge, Mass.: 5 lizards from Peru, 10 frogs and 4 lizards from Africa, 1 lizard from Ecuador, 2 frogs from Costa Rica. Exchange.

Myszka, C. S., Ukiah, Calif.: 4 specimens of plants from Ukiah, Calif. Gift.

Nast, Dr. Ernest, 4112 24th Street, San Francisco, Calif.: 291 insects, largely moths, taken in the Sierra.

National Herbarium, The, Washington, D. C.: 428 miscellaneous botanical specimens. Exchange.

Orcutt, C. R., San Diego, Calif.: 3 specimens of *Epiphragmaphora orcutti* Dall, from original lot. Gift.

Osterhout, Dr. W. J. V., The Rockefeller Institute for Medical Research, N. Y.: Calif. Acad. Sci. Proc. III Series, Vol. I, No. 6, 18 copies; Calif. Acad. Sci. Proc. III Series, Vol. II, No. 8, 127 copies; Calif. Acad. Sci. Proc. III Series, Vol. II, No. 11, 31 copies; Calif. Acad. Sci. Proc. Repr. III Series, Vol. II, No. 11, 36 copies; Univ. of Calif. Contributions from Botany Lab. No. 4, 36 copies (reprint from the Proceedings of the C. A. S. III Ser. Bot., Vol. I.)

Pacific Oil Co., and Associated Oil Co., 79 New Montgomery Street, San Francisco: Drill cores from 273 wells containing a very large collection of fossils micro-organisms. Gift.

Paul Elder & Company, San Francisco, California: Breasted—History of Egypt. Purchase.

Phillips, Warren, Game Warden, Golden Gate Park, San Francisco, Calif.: 1 *Canis ochropus ochropus*, in flesh, and 1 raccoon (male) from Golden Gate Park. Gift.

Peers, Miss Susie M., 52 Hillway Avenue, San Francisco: Current issues of "Science", for 1925. Gift.

Piazza, Enrico, 1312 Adams Street, Brownsville, Texas: 579 moths, mostly from Texas. Purchase.

Piper, C. V., Bureau of Plant Industry, Washington, D. C.: 3 botanical specimens from Oregon. Gift.

Pomeroy, C. S., Bureau of Plant Industry, Riverside, Calif.: 1 specimen of plant from Riverside, Calif. Gift.

Purdy, Carl, Ukiah, Calif.: 4 botanical specimens from Ukiah, Calif. Gift.

Ramp, Henry, Kenwood, Calif.: 2 specimens of plants from Kenwood, Calif. Gift.

Reagan, Dr. A. B., Cornfields via Ganada, Arizona: 36 land shells, collected at mouth of Gorge, 1 mile below Snowflake, Arizona. Gift.

Reimers, Milton A., Montebello, Calif.: 1 botanical specimen from Los Angeles, Calif. Gift.

Revillagigedos Expedition, California Academy of Sciences: 320 bird skins from the Revillagigedos, Tres Marias, Isabel, Guadalupe, etc.; 1 bottle of birds in alcohol; 8 bottles of bird crops in alcohol; 10 mammal skins and skulls from Tres Marias, etc.; 1 bottle bones; 1 bottle mammals in alcohol; 214 bird skins from Alijos Rock, Guadalupe, Clarion and Socorro Islands. Exploration.

Richards, Mrs. Virginia, S. S. Sierra, San Francisco: 1 pamphlet, Australian Museum Magazine. Gift.

Richards, Mrs. J. E., 2355 Polk Street, San Francisco, Calif.: 3 botanical specimens from Salinas, Calif. Gift.

Rixford, G. P., 1813 Pierce Street, San Francisco, Calif.: 6 botanical specimens from Santa Barbara, Calif. Gift.

Roberts, V., Flannigan, Nevada: 1 piece of Iceland Spar from Washoe Co., Nevada. Gift.

Robertson, G. D., Associated Oil Company, Los Angeles, California: 20 fossil shells from the Carboniferous of Colorado. Gift.

Robbins, Mrs. Lloyd M., 2203 Sacramento Street, San Francisco, Calif.: 1 nest from Paraguay. Gift.

Rose, Dr. J. N., National Herbarium, Washington, D. C.: 24 botanical specimens and 2 photographs of Dudleya. Exchange.

Royal Herbarium, Kew, Surrey, England: 112 Stolz African plants from near Lake Nyassa, 622 botanical specimens from the Himalaya Mts. Duthies Indian Plants, 175 Stolz African plants from near Lake Nyassa, 24 West Indian plants. Exchange.

Ruiz, Marian N., Comitan, Chiapas, Mexico: Ruiz—Nueva Teoria Cosmica. Gift.

St. Helens Petroleum Co., California: Fossil mollusks from oil well core, Sunset-Midway Field, Calif. Gift.

Shenefield, S. J., Steinhart Aquarium, San Francisco: 1 *Scapanus latimanus latimanus,* in flesh, from Golden Gate Park. Gift.

Slevin, J. R., California Academy of Sciences, San Francisco: 1350 specimens of reptiles and amphibians from States of Oaxaca, Vera Cruz, and Federal District of Mexico. Exploration.

Slevin, J. R., California Academy of Sciences, San Francisco: 1 lot of land snails from Mexico; 6 specimens of land snails from Federal District of Mexico; and 1 land snail from Oaxaca, Mexico. Gift.

Slevin, Louis S., Carmel, Calif.: 557 insects, mostly moths, taken about Carmel, Calif. Gift.

Showalter, A. N., Palo Alto, Calif.: 8 specimens of Hepatics from northern California. Gift.

Smith, H. J.: 1 large harlequin beetle from Panama. Gift.

Smith, Raymond L., California Academy of Sciences, San Francisco, Calif.: 1 botanical specimen from California. Gift.

Soares, A. J., Hayward, Calif.: 1 botanical specimen from California. Gift.

Stacey, J. W.: 1 book (Methods of Descriptive Systematic Botany). Purchase.

Standley, Paul C., U. S. National Museum, Washington: 1 pamphlet (Estudios Entomologicos). Gift.

Stechert, G. E.: 8 volumes, Verlandlungen, Zool.-Bot. Verins, Wien (Vols. 3, 4, 6, 10, 11, 32, 42, 43). Purchase.

Steinbeck, J. W., 611 Bristol Avenue, Stockton, Calif.: 1 *Polyplectron chinquis*, in flesh (domestic), 1 *Gallicolumba rubescens*, in flesh, aviary specimen from Marquesas Islands; 1 *Goura victoria*, in flesh (domestic). Gift.

Steinhart Aquarium, Golden Gate Park, San Francisco, Calif.: 1 *Phoca richardi geronimensis*, juvenile, in flesh, San Francisco; 1 turtle from India; 3 salamanders from Virginia. Gift.

Sutliffe, Mrs. E. C., 700 Lake Street, San Francisco, Calif.: 20 botanical specimens from Salmon Lake, Calif. Gift.

Swartz, Mrs. Peter, 3220 Mission Street, San Francisco: 1 mounted specimen of squirrel from Guatemala. Gift.

U. S. Customs, through Mr. F. Morales: 1 Quetzel. Gift.

U. S. Government Printing Office, Washington, D. C.: U. S. Official Postal Guide, July, 1925. Purchase.

U. S. Naval Receiving Station Personnel, Pier 14, Embarcadero, San Francisco: 5 specimens of *Heloderma horridum* (Mexican Beaded Lizard). Gift.

Van Duzee, Edward P., California Academy of Sciences, San Francisco, Calif.: The Van Duzee Collection of Hemiptera, containing about 30,000 specimens. Gift.

Van Duzee, E. P., California Academy of Sciences, San Francisco: 1732 insects from western Oregon, and 776 insects, mostly from Mill Valley, Calif. Exploration.

Van Duzee, E. P., California Academy of Sciences, San Francisco: 2 *Neotoma fuscipes fuscipes*, in flesh, from Marin County, California. Gift.

Van Dyke, Dr. E. C., University of California, Berkeley, Calif.: 1494 insects from Oregon and eastern Washington, and 657 miscellaneous insects, largely from California. Gift.

Van Dyke, Dr. Edwin C., University of California, Berkeley, Calif.: The Van Dyke Collection of Coleoptera, about 100,000 specimens. Gift.

Van Dyke, Dr. E. C., Berkeley, Calif.: 8 toads and 1 salamander from Washington; 2 frogs, 1 snake and 3 lizards from California. Gift.

Vortriede, William, Sacramento, Calif.: 80 botanical specimens from Eldorado County, Calif. Gift.

Walther, Eric, Golden Gate Park, San Francisco, Calif.: 115 specimens of exotic plants and 66 insects from Golden Gate Park, San Francisco. Gift.

Ward, Melbourne, Sydney, Australia: 5 lizards from Australia. Gift.

Webb, Mary E., 26 Micheltorena Street, Santa Barbara, Calif.: 2 botanical specimens from Ventura, Calif. Gift.

Werdermann, Dr. E., Santiago, Chile: 300 specimens of Chilian plants, mostly new. Purchase.

Werdermann, Dr. E., Casilla 3457, Santiago, Chile: 376 botanical specimens from Chile. Purchase.

White, Mary E., Waldo, Oregon: 20 botanical specimens from Waldo, Oregon. Gift.

Williman, E., Pescadero, Calif.: 2 snakes and 1 lizard from Pescadero, Calif. Gift.

Woods, Frank M., Argonaut Hotel, San Francisco, Calif.: 3 books: Schwatka's Hunting and Fishing Adventures in the Arctic Regions, White's Rediscovered Country, and Wright's Grizzly Bear; also 171 miscellaneous insects from about San Francisco, Calif. Gift.

Wright, Mrs. Dora E., San Francisco, Calif.: 4 pieces of highly fossiliferous limestone from Taishau, Chile Province, China. Gift.

Wright, Mrs. E. C., Mono Lake, Calif.: 71 plants from the Mono Lake region, California. Gift.

Wright, John T., Eureka Garage, Eureka, Calif.: 1 fossil coral from Taishan, China; 53 bird skins from Humboldt County, California; 11 bird skins from Trinity Co., California; 30 bird skins from Humboldt County, California; 1 *Sus*, mounted head; 1 *Sus*, skull; 1 *Hydropotes inermis*, mounted head; 1 *Felis chinensis*, from China. Gift.

Zanelli, Cecilia, Plantation, Calif.: 1 botanical specimen from California. Gift.

FINANCIAL STATEMENTS

REPORT OF THE TREASURER

For the fiscal year ending December 31, 1925

January 1, 1925, Balance with Crocker National Bank		$ 3,374.61
Receipts:		
Dues	$ 4,327.75	
Charles Crocker Scientific Fund Endowment Income	1,693.05	
James Lick Endowment Income	68,137.11	
General Income	17,918.61	
John W. Hendrie Endowment Income	960.00	
U. S. Treasury Certificates	6,000.00	
Bills Receivable	11,000.00	
Bills Receivable, Ignatz Steinhart Trust	10,000.00	
Ignatz Steinhart Trust Interest	535.00	
Interest	835.54	
Ogden Mills Donation	1,000.00	
Publication	647.01	
W. G. Wright Fund	56.00	
Wild Life Protection Fund	600.00	
Post Card Sales	1,534.84	
Tools and Equipment	50.00	
Park Birds Hand Book Fund	20.00	
Sundry Accounts	510.90	
		$125,825.81
		$129,200.42

REPORT OF THE TREASURER—Continued

Expenditures:

Interest	$13,277.43	
Contingent Fund	546.51	
Salary Expense General	18,655.82	
Museum Department Appropriations	11,570.88	
Museum Department Salaries	14,212.69	
Publication	3,557.62	
Holbrook Installation	1,796.19	
Grizzly Bear Group	318.39	
Library	3,940.55	
Steinhart Aquarium Equipment	3,188.40	
Bills Receivable, Ignatz Steinhart Trust	10,000.00	
Bills Payable	15,000.00	
Bills Receivable	16,000.00	
U. S. Treasury Certificates	2,000.00	
Revillagigedos Expedition	2,435.27	
Sundry Creditors	11,449.34	
Expense	2,615.88	
Wild Life Protection Fund	302.40	
Insurance	1,663.16	
Earthquake Sinking Fund	400.00	
		$132,930.53

December 31, 1925, Balance due the Crocker National Bank... $ 3,730.11

M. Hall McAllister, *Treasurer.*

Examined and found correct,
McLaren, Goode & Co., *Certified Public Accountants.*
San Francisco, Calif., February 17, 1926.

INCOME AND OPERATING EXPENSES

For the fiscal year, January 1, 1925, to December 31, 1925

Income:		
Charles Crocker Scientific Fund Endowment Income		$ 1,693.05
James Lick Endowment Income		68,137.11
General Income		17,918.61
Dues		4,427.75
Interest from Temporary Investments		835.54
Profit on Post Card Sales		620.20
Total Income		$93,632.26
Expenditures:		
General Expense	$ 2,945.63	
Salaries	32,149.33	
Interest	13,277.43	
Insurance	1,697.16	
Total Expenditures		$50,069.55
Net Income Transferred to Surplus Account.		$43,562.71

SUMMARY OF SURPLUS ACCOUNT

December 31, 1925

Balance January 1, 1925		**$434,370.21**
Additions:		
Net Income for Year ended December 31, 1925	$43,562.71	
Sale of Microscope	50.00	
Henry M. Holbrook Bequest of Dec. 4, 1924	2,000.00	
Income from J. W. Hendrie Endowment Account	4,335.00	
W. G. Wright Fund	97.92	
Total Additions to Surplus		$ 50,045.63
		$484,415.84
Deductions:		
Depreciation:		
Office Furniture	$ 292.60	
Commercial Building	10,336.37	
Museum Building	3,840.52	
Tools and Equipment	867.54	
		$ 15,337.03
Surplus, December 31, 1925		**$469,078.81**

IGNATZ STEINHART TRUST

December 31, 1925

Amount of Fund:

Bequest from the Ignatz Steinhart Estate....		$250,000.00
Interest from temporary investments.........		56,012.70
		$306,012.70

Disposition of Fund:

Steinhart Aquarium Construction............	$263,390.29	
Steinhart Aquarium Equipment..............	26,901.73	
Temporary Investments:		
Bills Receivable	10,000.00	
Revolving Fund	5,000.00	
Uninvested cash on hand....................	720.68	
		$306,012.70

BALANCE SHEET

December 31, 1925

Assets

Property:		
Real Estate, 831-833 Market Street	$600,000.00	
Commercial Building, 833 Market Street	516,818.66	
Real Estate, Jessie Street	8,083.65	
		$1,124,902.31
Museum, Golden Gate Park:		
Construction	$192,025.92	
General Collections	158,482.01	
Library and Equipment	95,103.11	
Tools and Equipment	36,779.73	
Office Furniture	4,179.96	
		$ 486,570.73
Investment Securities		14,200.00
Ignatz Steinhart Trust:		
Bills Receivable	$ 10,000.00	
Steinhart Aquarium Construction	263,390.29	
Steinhart Aquarium Equipment	26,901.73	
Steinhart Aquarium Revolving Fund	5,000.00	
Uninvested cash on hand	720.68	
		$ 306,012.70
Current Assets:		
Bills Receivable	$ 13,000.00	
Foreign Exchange	36.84	
Post Cards in Stock	2,495.99	
Cash on hand	124.78	
Sundry Accounts	143.10	
		$ 15,800.71
Total		$1,947,486.45

BALANCE SHEET—Continued

Liabilities

Endowments:		
James Lick Endowment	$804,902.31	
Charles Crocker Scientific Fund Endowment.	20,000.00	
John W. Hendrie Endowment	13,600.00	
		$ 838,502.31
Ignatz Steinhart Trust:		
Ignatz Steinhart Trust	$250,000.00	
Ignatz Steinhart Trust Interest	56,012.70	
		$ 306,012.70
Alvord Bequest Botanical		5,000.00
W. G. Wright Fund		81.28
Ogden Mills Donation		1,000.00
Park Birds Hand Book Fund		20.00
Wild Life Protection Fund		432.56
Reserve for Depreciation		86,508.74
Bills Payable		235,000.00
Sundry Creditors		1,399.26
Amount due Ignatz Steinhart Trust	$ 720.68	
Crocker National Bank (overdraft)	3730.11	
		$ 4,450.79
Surplus		469,078.81
Total		$1,947,486.45

W. W. SARGEANT,
Secretary,
Board of Trustees.

We have examined the foregoing Balance Sheet, together with the books and accounts of the California Academy of Sciences, and, in our opinion, it is properly drawn up so as to exhibit a true and correct view of the Academy's affairs, as shown by the books.

McLAREN, GOODE & CO.,
Certified Public Accountants.

San Francisco, Calif.
February 17, 1926.

Date of Issue	Date of Issue	Date of Issue